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F. A. WIRT, President — RAYMOND OLNEY, Secretary-Treasurer

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American Society of Agricultural Engineers

THE American Society of Agricultural Engineers is the national organization representing the agricultural-engineering profession. It is the principal source of and clearing house for technical information and data in its field. Its function is to provide a central point of contact for agricultural engineers—to coordinate their efforts in developing the science and art of engineering as applied to agriculture. Its principal objective is to formulate a distinctly agricultural-engineering science, based on engineering technique and specific agricultural requirements, to serve as a foundation for the profession.

Agriculture, the oldest and most fundamental of all industries, is the last to be engineered. Progress in this direction is still far behind that attained in transportation and manufacturing. But the agricultural engineer, visualizing the future and fighting his way through precedents and orthodoxies, is making real progress in putting agriculture on a sound engineering—and consequently economical and efficient—basis. He foresees not only the necessity for, but the realization of a development of agriculture along engineering lines as far-reaching as that already attained in the manufacturing industries and transportation.

The difficulties which now and have heretofore beset agriculture are due largely to a lack of proper engineering. It is the agricultural engineer's duty then to keep the development of engineering science abreast of the requirements of a rapidly developing agriculture.

The engineering requirements of agriculture are, to a large extent, quite unlike those in any other field. The need for the development of new principles and data to meet these requirements is particularly apparent. The projects for investigation and study that might be undertaken by agricultural engineers are legion, many of which call for the most fundamental research. Outstanding progress has been made in this direction and real achievements have been recorded, but the field is yet new and the surface has scarcely been scratched.

This emphasizes the desirability—if progress is to keep pace with the need—of the closest possible cooperation and understanding between individuals and groups interested in promoting all phases of agricultural engineering. Obviously the most effective and most logical agency for fostering this cooperation and understanding and for coordinating individual and group efforts is the national organization representing this field—the American Society of Agricultural Engineers.

THE manufacturer of implements or tractors who entrusts you, as an engineer, with the details of construction and design, relies on your skill and good judgment to select materials that will maintain the reputation that he has built up.

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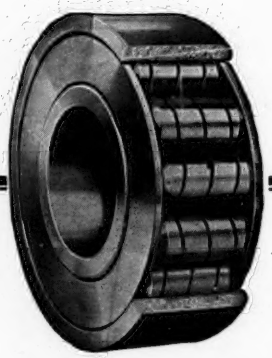


AGRICULTURAL ENGINEERING

The Journal of Engineering as Applied to Agriculture

RAYMOND OLNEY, Editor

Vol. 6 OCTOBER, 1925 No. 10

EDITORIALS

More Machinery

ONE authority says that our per acre yields are too low, another authority is of the opinion that more power and more efficient farm machinery should be used on our farms in order to solve the problem of accomplishing with the greatest economy the work to be done, while a third authority is shouting from the housetops that cooperative marketing is the remedy for all the farmers' ills. Now, the truth of the business is our per acre yields should be increased, more power and better farm equipment should be used on our farms, and we should sell our crops cooperatively in an orderly manner. All three remedies should be used.

The most intelligent farmer will fail on poor land unless he builds it up. A systematic rotation of crops including legumes should be practiced on every farm and the larger part of the crops grown should be fed to good livestock. Strong teams and tractors and large plows should be used to turn under all vegetable matter. Manure spreaders should be used to apply all barnyard manure to the poorest acres; and fertilizer distributors should be used to make liberal applications of commercial fertilizers wherever needed.

Greater production per man does not stop with greater acre-yields. The final test is the acre-yield per man, and, finally, the farm profits per man. And let us always remember that labor-saving farm machinery is doing more than any other one thing to make possible greater production per unit of man labor on the farm, and that means greater farm profits. Farming is a business where brains count, and nowhere is this more apparent than in the use of labor-saving, time-saving, money-making farm machinery.

G. H. ALFORD

"Telling the World"

"TELLING THE WORLD" about the American Society of Agricultural Engineers is the moral duty of every member of the Society, not only to the "world" but to the Society itself. There are many eligible candidates for membership to be found in different lines of work who ought to seek the privileges of membership and the service which the Society is in position to render. Many of these men are no doubt so, largely no doubt because they do not know about the Society.

The following instance serves as an everyday example: Several years ago an inventor, who proposed to revolutionize agriculture, designed and built a machine at a cost of over one-half million dollars, according to his own statement. He personally financed the proposition and supervised demonstrations direct to farmers. It is quite certain that there was never any publicity, comment, or criticism sought from members of the American Society of Agricultural Engineers, and it is equally certain that not one of his machines is in use on a farm today.

No doubt the machine was too specialized, but how can anyone afford to put a new machine on the market without consulting this organized group of information seekers and givers?

We, as members, owe it to the Society to further its growth, but we are equally bound to do the job of educating the public to the existence of the Society devoted to service in all branches of engineering as applied to agriculture.

D. B. LUCAS

A Lifetime Job

DURING the early stages of a great war, President Lincoln, on July 2, 1862, signed a bill which became known as the Morrill Act, whereby each state could establish a college of agriculture and mechanic arts and receive federal aid in maintaining it. For many years these institutions groped, first looking for teachers, then trying to decide what to teach and how to teach it. It took forty years to build up good courses and then build the demand for them. The last twenty years has seen a realization of this forty years of building.

During the early stages of another great war, shortly before we entered into it, another president, Woodrow Wilson, on February 23, 1917, signed a bill known as the Smith-Hughes Bill, which again allowed the states to establish another great educational system and receive federal aid in maintaining it. The Smith-Hughes Act provided for the promotion of education in agriculture, the trades, and industries in the secondary schools.

Agricultural engineering was one of the last courses to be added to the curriculms of the great institutions that grew out of the first act. Some of those institutions do not even yet have a well developed agricultural engineering course, after sixty years. On the other hand, agricultural engineering is the first, or nearly so, to be established under the second great act of Congress. The thought then occurs, Will it take forty years to perfect this course? Yes, because educational work is never perfected. This being the case there is room for a very large number of agricultural engineers to put in an entire lifetime in the building of Smith-Hughes courses in the secondary schools.

The agricultural engineer is the best person, fitted by education, at the present time to be a successful teacher of Smith-Hughes courses, for the reason that in many schools this teacher must handle both the agricultural and engineering work. Brother agricultural engineers, look into this. The salaries are such as to allow anyone to live well; the working with boys in their plastic stage is an inspiration; your contacts with their parents and their farm problems will keep you from getting rusty and keep you out of the rut into which, all too often, other lines of teaching lead you. The sky is the limit as to the amount of good one can accomplish, because of the vast number with which you come in contact in Smith-Hughes work.

MARK HAVENHILL

Attend the Meetings

EVERY professional man is in need of contact with other members of his profession. It is one of the big contributing factors to the advancement of the individual. The man who attempts to be sufficient unto himself usually ceases to progress.

Agricultural engineers especially, because their profession is yet comparatively new, need frequent contact with others in their profession. The meetings of the American Society of Agricultural Engineers are primarily for the purpose of encouraging such contact. Therefore, every agricultural engineer should attend as many meetings of the Society as possible. It costs money to do so, but it is one of the best investments he can make toward his professional advancement and standing.

Some Agricultural Engineering Problems of Western Irrigation Practice*

By S. H. Beckett

Mem. A.S.A.E. Associate Professor of Irrigation Investigations and Practice, University of California

AGRICULTURE under irrigation may be correctly referred to as one of the oldest industries. Scattered throughout the world, in Egypt, India, Southern Europe, China, Peru, Mexico, and Southwest United States, and dating back to as far as 1700 B. C., are found the remains of an abandoned agriculture once highly developed and dependent upon irrigation. Whether the failure of these enterprises was due to engineering, economic or agricultural causes has not been satisfactorily explained. Whatever the cause may have been, their existence is responsible for the statement that "it has yet to be proven that a permanent agriculture is possible under irrigation." Broadly speaking the irrigation problem of today is primarily agricultural; it is the problem of developing and maintaining permanent agriculture wherever irrigation is practiced.

However, no matter what the failures in the past may have been, or what may have been the cause, those of us interested in the engineering problems of irrigated agriculture look into the future with optimism. Failure of agriculture under conditions or properly applied results of scientific investigation has not been proven.

The field of irrigation may be divided into three phases: irrigation engineering, irrigation economics, and irrigation practice. The irrigation engineering problems are those involved in the development and delivery of the water supply, based on safe engineering practice and at a cost, which under normal conditions of production will assure the success of the project. These problems are strictly of an engineering nature, and although often demanding the highest engineering skill are governed by established laws and practices, both in design and construction.

The problem of irrigation economics is one of determining, first, if the agricultural returns will justify the expenditure and, second, of so financing the project that the water user will have at least an even chance to meet the obligation incurred by the development.

The agricultural phase, although generally assumed to be simple, chiefly because it is agricultural, is the phase of the development upon which the success of the project rests. Agriculture carries the financial burden of irrigation development. It is agriculture which must pay for construction costs as determined by the engineer, and under the conditions of payment determined by the economist.

Irrigation practice has been defined as "the artificial application of water to the land for the production of crops," and its problems are those which deal primarily with the development, transportation, and distribution of water on the farm, and its proper application to the crop.

Problems of Water Supp Development

In the development of a private water supply, the prospective user either obtains water by gravity diversion from river or stream, or by pumping from open channels or wells. The design and construction of diversion works from open channels usually present no problems of a difficult nature. However, if the development involves the purchase of pumping machinery, the purchaser is immediately confronted with a series of perplexing problems of an engineering nature.

Conservative estimates place the number of pumping plants in operation in the United States at 35,000, California reporting the use of 21,000 individual plants in 1920.

The average irrigation plant is usually used in pumping from wells under lifts ranging from a few feet to a maximum of 350 feet; furthermore, these wells may be under conditions of seasonal fluctuating or gradually receding water table. Stored in the archives of pump manufacturing concerns, university, state and federal offices are hundreds of tests of the efficiencies of these plants. Although in general these tests show low efficiencies, but little progress has been made in determining the causes of these low efficiencies or in finding a remedy for their improvement. The problem in pumping for irrigation is chiefly a problem of standardization. First, a standardization of methods and equipment for testing of wells which will furnish information permitting the installation of proper equipment, and, second, if possible a standardization of the guarantee under which pumps are purchased. In addition to this more information is needed concerning the adaptation of various types of pumping machinery to varying conditions of lift, especially where definite information has been made available through a testing of the well. Finally we should have available additional information concerning the economics of pumping. By this is meant, first, a careful analysis of conditions which warrant the purchase of pumping machinery and, second, the economic capacity of the plant in view of the cost, the acreage to be irrigated, the period of operation of the plant and the cost of operation especially under conditions of the "sliding scale" charge where electricity is used.

Problems of Water Distribution on the Farm

Under this may be included the following:

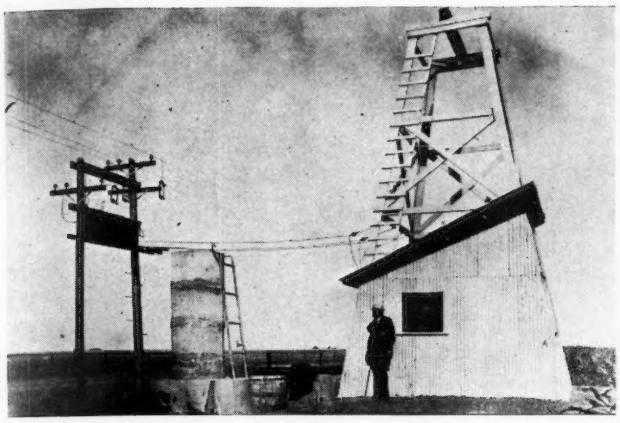
(1) Design and construction of farm ditches.
(2) Farm irrigation structures.
(3) Measurement of irrigation water.
(4) Seepage losses and ditch linings.
(5) Design and construction of conduit systems of delivery, including the use of steel, wood stave, concrete and burned clay tile.

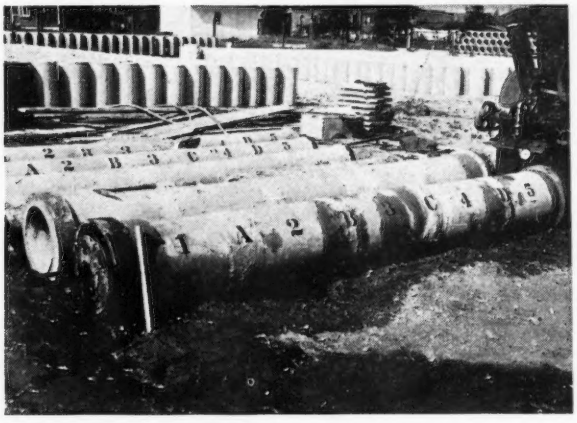
To the agricultural engineer the first three of the above present no problems of major importance. Improvement is always possible and such problems as more efficient machinery and better methods of construction of farm ditches; standardization of design for farm irrigation structures and the adaptability of these designs to the various soil types in which the structures may be placed; simplification of methods of measuring water on the farm especially under conditions of widely fluctuating heads both in open channels and closed conduits, are all of sufficient importance to justify consideration.

The problems of seepage losses are not only important due to the economic loss through waste, but also are a constant menace to the water user. Ultimately water lost by seepage must be reclaimed by drainage. Measurement of these losses although indicating the general extent of the loss are of little use where they do not lead to preventative measures. Much valuable work has been done in a study of seepage losses and lining of large canals. This information should be made applicable to smaller ditches and laterals of the farm, especially in comparing their adaptability, cost and their efficiencies when compared to the underground delivery systems.

In the design and construction of underground distribution systems on the farm, there is opened up to the agricultural engineer a practically untouched field for investigation and research. One western state alone reports an estimated installation of 1200 miles of concrete pipe per year. Although methods of manufacture are constantly being improved and recent years have shown very appreciable improvement in quality of pipe manufactured, but limited investigations have been made to determine tensile strength, imperviousness and other qualities as developed under different methods of manufacture and curing.

*Paper presented at the nineteenth annual meeting of the American Society of Agricultural Engineers, Madison, Wisconsin, June, 1925.





(Left) A typical irrigation pumping plant. It is estimated that there are 30,000 such plants in operation in California. (Right) Concrete pipe undergoing tests for seepage and tensile strength

The problems of pipe manufacture may be briefly listed as follows:

(1) Investigations into methods of manufacture, including the selection, grading and mixing of materials.

(2) Methods of curing new made pipe.

(3) Expansion and contraction of pipe including effects of variation in soil and water temperatures, depth of laying, method of laying, use of expansion joints, etc.

(4) Standardization of outlet structures including the design and installation of pressure stand, relief stands, delivery gates, division boxes, sand traps, etc.

(5) Costs and adaptability of concrete pipe in comparison with the use of the steel pipe, wood stave pipe, burned clay tile, or the lined open ditch.

Although these may be considered primarily as manufacturing problems, they are of importance to the water user, who in the final analysis is the one who profits if the installation is a success, and loses if it fails.

Problems in the Use of Water on the Land

The problems in connection with the use of water on the land may be simply stated as follows:

(1) Water requirement of irrigated crops including the whole field of relation of plant growth to moisture supply.

(2) Method of application, including the whole field of soil moisture movement.

(3) Preparation of land for irrigation.

In other words, this is a problem first, of determining the economic water requirement of the crop to be irrigated including the proper time and frequency of irrigation; second, to determine the method of application under which existing conditions will permit the most uniform distribution of water through the soil mass; and, third, the proper preparation of land which will permit this uniform distribution.

Almost since the beginning of modern irrigation practice observations in the shape of so-called "duty of water investigations" have been made of existing uses and practices. Measurements almost without number have been made of quantities of water, both gross and net, which ditch companies and individuals have been using. The problem is not one of how much are they using but how little should they use. If we hope to maintain a permanent agriculture on our irrigated lands, water must be applied to meet the demands of the crop to be irrigated. The information needed can only be obtained by a fundamental study of the basic principles underlying the use of water by plants, determining first their theoretical requirement and then as nearly as possible meeting that requirement through unimproved methods of application.

In considering methods of application the problem is basically one of soil moisture movement. Theoretically, a proper application of water demands that the effect of mechanical and chemical composition of the soil on moisture movement be known. Observing water users have noted that the rate at which their soils absorb water is constantly changing. Why? What is the effect of existing moisture content on the rate of soil moisture movement? To what extent does the volume weight and moisture equivalent of soil change under irrigation, and is there an actual transportation of soil particles through the soil mass during irrigation? When we have answered these, we can more intelligently talk of irrigated methods and more properly advise as to methods of preparation of land.

The above are but a few of the problems of present day irrigation practice; they are problems of agricultural engineering, that is, the science of engineering applied to agriculture. When we have solved some of them, irrigation practice may be more simple.

A Point of Contact Essential

The importance of a central clearing house to which all agricultural engineers can turn for information and guidance is obvious. That is why an organization such as the American Society of Agricultural Engineers is essential to the general development of the field of agricultural engineering and to the advancement of individuals in that field. Such an organization obviously has numerous functions, but the most prominent and important collective function of the Society is undoubtedly its activity in promoting development in the field of agricultural engineering for the benefit of all its members. As a result of this activity, the whole category of agricultural engineers, including teachers, extension specialists, research engineers, consulting engineers, and designers and manufacturers of farm equipment, constantly look to the Society for a certain amount of information and guidance to keep them up to date and abreast of the development of the profession. In other words, A.S.A.E. is an essential point of contact.

Rural Electric Service Costs*

By E. A. Holloway

Sales Engineer, Iowa Railway & Light Company

IN AN effort to determine the real situation as to the cost of rendering rural electric service, an extensive study of actual conditions existing on a part of the system has been made by the company with which I am associated. In making the study it was felt that attention should be given to the entire costs from the power house to the consumer's meter and not start the study with the assumption of adequacy of the present urban rates and make rural rates by simply adding the excess cost of rural service to the present urban rate schedules. If errors exist in any present urban rate, it was thought best to eliminate such errors from the rural rates before the rural business became extensive. While the present urban rates bring in the correct total revenue as a whole we know that they are discriminating as between consumers and as between towns. We feel that our rural business should be developed on economic principles and that we have an opportunity to direct its growth on a sound business basis, profiting by our errors in the past. While in many cases it will undoubtedly be easier for the sales department to start with present urban rates, and, from an educational standpoint, may be the best way at present, yet it is certain that eventually power plant and transmission costs must be introduced accurately and presented in a rate form that follows closely the cost curve. This will also be the form of urban rates in the near future.

Rural consumers represent a distinct class of service and the elements entering into the cost of that service should be determined without regard to the other classes of service. After one takes the items out of the urban rate that are not applicable to rural service costs, he has little left and there is so much to add.

There are at present many different varieties of rural rates. In some the service companies own and maintain the distribution line and the consumers the transformers and service line. In some the consumers own and maintain all equipment. The insurance problems on these lines are in many cases in doubt. There seems to be a trend toward the service companies ownership of all equipment, and it is on this basis that we build our rate and contract.

After a careful study we find that the following items go to make up the cost of rural electric service regardless of who owns the equipment, each is separate unto itself and has no relation to any other item and none of these items except the last bears any relation to the number of times the kilowatt-hour meter revolves. The items are as follows:

(a) Meter and billing costs
(b) Service line costs
(c) Transformer costs
(d) Distribution line or pole line charge
(e) Demand charge
(f) Electricity rate

Meter and billing costs are similar and almost identical with the urban consumer costs, and are made up of the commercial office expense, consumer portion of general expense, meter shunt coil costs and investment expenses on meters, plus an item due to inspection service and greater meter investment expense, which occurs in rural service and does not appear in the cost of urban service, which was found by a test made, which included forty towns and eight cities, comprising 31,778 consumers; this amount we found to be 60 cents per month per consumer.

The service line cost is the cost of the line from the pole line to the meter. In the event the pole line is located on a highway, this distance is taken from the center of the road to the location of the meter regardless of the location of the transformer. If the pole line is located on a private right of way then the length of the service line is taken from the point of contact with the pole line to the location of the meter. This item is found by itemizing the equipment necessary to run a service line a few hundred feet and divided by the number of feet, getting the cost of service line per foot. This amount we found to be 5.0 mills per lineal foot. The cost found per foot of service line is used only for those service lines which are of an average length, which is found to be from 150 to 300 feet. In the event this service line is one-quarter or one-half mile in length the service line costs are figured specifically for that case.

The transformer costs include investment costs on the transformer, lightning protection, cutouts, etc., plus labor of installation and core losses. We have based our costs on 6600-volt transformers.

The transformer core loss cost is taken at 1.8 cents per kilowatt-hour, which is cost of fuel, boiler room labor and water for boilers, these being the only items which vary directly with the kilowatt-hours consumed. No portion of the demand charge or power plant capacity costs are included in the kilowatt-hour charge for determining core loss costs.

The transformer charge varies from $3.10 per month for a 1½-kilovolt-ampere transformer to $3.90 per month for a 5-kilovolt-ampere transformer.

The pole line charge is based on a 6600-volt, single-phase line. When a line is built to serve a town or city and the business warrants the building of the line it is called a transmission line, and a portion of the transmission line charge is included or should be included in the rates to the consumers in the town. Therefore, the pole line charge should be eliminated from those rural consumers along this transmission line, if it be a 6600-volt line. This is accomplished automatically by placing in each consumer's demand charge an item of 50 cents, which represents the transmission line cost per demand month. Now with a rural line which is not necessarily a transmission line, the item of 50 cents for each kilowatt demand month is automatically added to the demand charge item and taken from the pole line investment costs. When the kilowatt demand of this line becomes 30 kilowatts per mile, the pole line charge disappears, and the line becomes a transmission line. It is quite evident from this why the pole line charge to the rural consumer is large when you know that in this state (Iowa) there is an average of two and one-half consumers per mile of line with a billing demand of possibly 5 kilowatts per mile of line.

The monthly billing kilowatt demands need not be measured each month but can be determined quite accurately from connected load. Tests show that the average residence maximum demand is 778 watts. The test was made on consumers who were thought to be somewhat above the average, and urban residence in all our calculations have been given an average of 750 watts. The largest load was 1.1 kilowatts. It was decided that the number of maximum variations were so few and the difference in demand costs for the ordinary variation from the average would not offset the extra cost and complications of placing residences, which comprise about 85 per cent of our consumers, on a metered demand basis, or even to base the demand on equipment installed so long as the largest device is limited to 750 watts. We believe that an average demand can be obtained which would meet 95 per cent of the conditions with a maximum discrimination in costs no greater than would be the extra cost of a measured demand.

No data was available on rural business, but as there will be more lights due to the farm buildings, it was thought one kilowatt would be a safe value where no device exceeds 750 watts. Where a device larger than socket devices was

*Paper presented at the Rural Electrification Conference, Madison, Wisconsin, June 26, 1925, under the auspices of the Committee on the Relation of Electricity to Agriculture.

used, is was assumed that devices up to 2½ kilowatts, due to the greater diversity in farm use of large devices over commercial urban use, would have no greater demand on the transmission line and power plant of a number of farms than would ½ kilowatt for the same number of urban users. Likewise a device larger than 2½ kilowatts, but not larger than 6 kilowatts, is given as the equivalent demand of one kilowatt and a device larger than 6 kilowatts, but which is not too large for a 5-kilovolt-ampere transformer would have an equivalent demand of 1½ kilowatts. These added to the one kilowatt for the socket devices gives 1½, 2, and 2½, respectively, as the monthly billing demands where devices larger than socket devices are installed.

As the tests on rural service progress, and very careful data is being collected on the Garner farm line, it will be proven whether or not the above diversity factors are correct, but we feel that they will not be found far off if not correct.

With a pole line cost of $1,000 per mile and insurance, taxes, interest (money cost), depreciation, maintenance and operation, plus 15 per cent of these investment rates for contingencies, profit and general expense amounting to 18 per cent per year, or 1.5 per cent per month, we get a pole line investment cost of $15 per month per mile of line.

Let us assume that there are three consumers per mile. Consumer No. 1 has a billing demand of one kilowatt having only socket devices; consumer No. 2 has a billing demand of 1½ kilowatts; and consumer No. 3 has a billing demand of 1½ kilowatts, both having devices larger than socket devices but not exceeding 2½ kilowatts. The sum of these billing demands is 4 kilowatts per mile of line. As there will be 50 cents per kilowatt of billing demand in the demand charge, which is a portion of the pole line charge, then 50 cents times 4 kilowatts, or $2, will be subtracted from the $15 pole line charge per mile, leaving a charge of $13. This divided by 4-kilowatt billing demand per mile of line gives us $3.25 per kilowatt of billing demand.

Consumer No. 1 pays 1 times $3.25, or $3.25; consumers Nos. 2 and 3 each should pay 1½ times $3.25, or $4.88, for their portion of pole line charges. We received then the sum of $3.25 plus $4.88 plus $4.88 plus the $2 demand charge, or $15.01, for the pole line charges per mile of line, and the charge is divided equitably among the consumers on the basis of the benefit each derives from it.

This would be applied not by figuring each mile separately but by dividing the territory into districts and calculating beforehand what the probable number of consumers will be per mile each with a billing demand of one kilowatt or 1½ kilowatts. Companies should begin to lay out the rural territories into districts.

The demand charge includes the capacity expenses which consist of all transmission costs, and of all production costs, except fuel, boiler room labor and water (for boilers). The latter expenses are classified as energy expenses. Although this division of production expenses is not technically correct, since a small portion of fuel, boiler room labor and water expenses are truly a capacity expense and a small portion of the other expenses are truly energy expenses, yet, after making a careful analysis, it has been found that the use of this simple method of division does not introduce an error of more than two per cent over what the results would be if obtained by the more complicated method of division. Interest at the average rate of the cost of money on interest bearing obligations and preferred stock is included as an item of expenses. The production and transmission expenses were obtained by an allocation of the company's expenses by the company's "Standard Manual for the Determination of Unit Costs of Electric Service."

The demand charges or capacity expenses are more difficult to take care of in rates, that is, to do so in an equitable manner than are any of the other costs. If they are introduced as a flat kilowatt-hour charge, then all those consumers who used the equipment longer hours than the average pay more than they should, and those who use the equipment shorter hours than the average pay less than they should. If the capacity expenses are introduced as a flat demand charge found by dividing the expenses by the sum of the demands of all the consumers, then those consumers who use the equipment longer hours than the average pay too little for the service, and those who use the equipment shorter hours than the average pay too much. These statements are made clear by the following examples:

This farm is equipped quite extensively for the utilization of electric service. Note the yard light and pole. In the small building in the foreground the owner has installed considerable electric equipment

1. Assume a 100 per cent load factor consumer with a demand of one kilowatt. He should pay for the capacity expenses an amount found by dividing the total capacity expenses by the maximum load on the system. This, say, is $7 for one-kilowatt demand. Assume the capacity expenses divided by the number of kilowatt-hours is 3.7 cents per kilowatt-hour, then the kilowatt-hours used per average month by a 100 per cent load factor consumer would be 730, and the cost at 3.7 cents would be $27.28 minus $7.00, or $20.28 more than the cost of the service.

2. Assume that the same expenses divided by the sum of the consumers' demands is $1.88. It will be seen in this case that the 100 per cent load factor consumer is served for $7.00—$1.88, or $5.12 less than cost. All the above values are consistent in actual practice.

From the above it is evident that by some combination of these two methods, wherein part of the capacity expenses are made to function with kilowatt-hours and the balance with the maximum demands of the consumers, an accurate and equitable method would be had for introducing the capacity expenses into rates. The proper combination and values can be readily obtained from two simple equations which are given and solved in the detailed supporting data which is a part of this paper.

By applying the results obtained from the test mentioned above on forty towns and eight cities and solving the equations as the detailed supporting data will show, we find that the portion of the total capacity expenses that can be made to function with the kilovolt-ampere maximum demand is $1.00. The demand charge then is taken as $1.00 per kilowatt of monthly billing demand. The monthly billing demands are those as determined by the pole line charge.

Also from this solution we find that the portion of the total capacity expenses that can be made to function with the kilowatt-hours supplied the consumer is 6.9 mills per kilowatt-hour.

The electricity rate includes the total energy expenses which are the fuel, boiler room labor and water (for boilers) expenses divided by the number of kilowatt-hours registered by the consumers' meters. During the above test this was found to be 1.608 cents per kilowatt-hour. This amount increased by 12 per cent to cover contingencies, factor of safety, and profits gives 1.8 cents the amount applied to the transformer core losses; and the amount of 1.608 cents plus the 6.9 mills demand charge plus 25 per cent to cover contingencies, profits, and a factor of safety, gives 2.9 cents per kilowatt-hour for the electricity base rate.

In a previous paragraph, relative to the pole line charge, we explained the method of assigning a monthly billing demand to each rural consumer on which to base their demand charge and from which to determine the number of kilowatts of demand per mile or demand miles per mile. The rural consumer should receive credit if a small settlement or a power load is connected. However, in many cases the small settlement or the power load such as a consolidated school or elevator causes the line to be built three-phase. As this is a possibility then the entire billing demand of such power load (which is not determined in the same manner as the rural but by actual demand) should not be used to determine the number of demand miles of the line. For this purpose 85 per cent of the demands of a power load having a small load which could be carried by a 5 kilovolt-ampere transformer and 70 per cent of the demand of a larger power load is used to determine the demand miles of the line.

The demand of residence consumers in a small town which is used to determine the demand miles of the line can be set out in a table. This table appears in the rate sheet which is a part of this paper. The demand of these residence consumers is used only to determine the demand miles of the line as the rates charged these consumers will be the standard rates for small settlements.

The rate sheet need not be presented to the ordinary rural consumer or even an attempt made to explain it to him. When these items are properly calculated, which is really very simple after one carefully reads it through, they will appear in the contract as one sum known as a monthly charge. This paper, the rate sheet and the detailed supporting data are for those who are the leaders. If the leaders approve them, and the leaders will be not only public service company men, but the farm bureau, various farm organizations, farm papers, etc., and the rural consumers know of the approval, there will be no explanation to make. There will continue to be disbelief on the part of the rural consumers as long as there are as many different rate forms as there are organizations.

The values for the six items listed in the first part of this paper will not be the same on all systems, but we feel that these are the items to be considered.

After a careful study of rural costs one wonders why the kilowatt-hour meter plays such an important part. If we have to give something away, let's discard the meter and insist on the other charges. At the present consumption of a majority of the rural consumers the electricity rate hardly equals the investment cost of the service line let alone the billing expense, transformer costs, pole line and power plant capacity costs. Even at a consumption of 200 kilowatt-hours per month the electricity rate just about equals the pole line charge plus the service line charge, not including the transformer or billing expenses on an average Iowa rural line.

When all the rural consumers are equipped with electric service, the application of this rate will be a very simple task; in fact, then many of these items can be grouped as they are in any other class of business. That time will probably come, but there should be no losses to anyone during this promotion period. Many rates are correct at one or two points on the cost curve, but that is no sign they are correct all along the curve.

When a group of farmers whom you have been serving over a line and transformers, which belong to them, come to you, after they have had service for some time and their maintenance bills start, and ask you to take the line off their hands (and they are willing to give it to you) and in many cases we are foolish enough to take it in accordance with their ideas, it is easy to show them by the above items how this simple operation of presenting the service company with some equipment affects the costs.

It is a simple matter to show them what happens under different conditions due to his or your ownership of different parts of the equipment which goes to make up a rural line. If the rural consumer should happen to hear even approximately the same story twice by two different service men, he would believe us.

As to the contract, there are only a few items which we wish to mention, as we feel that the contract itself is not important. Any form can be made up as a majority of the clauses contained therein are fairly standard. It should contain no part of the rate except a place for the total monthly charge designating the size of transformer, length of service line, number of demand miles of the line and billing demand on which the monthly charge was based, with the base rate per kilowatt-hour.

We believe the owner should be the signer of the contract; in this I believe most of us agree.

We also believe the contract should be at least of fifteen years duration. This is objected to by many, especially the rural consumer, yet he is perfectly willing to build his own lines and accept all the responsibility, the same responsibility that we asked him to share with us when he signs for fifteen years.

RATE NO. 61 OF THE IOWA RAILWAY AND LIGHT COMPANY

(NOTE: This rate applicable to rural electric service from a rural distribution system financed, owned, maintained, and operated by the company, and is available for rural consumers (owners) who can be served with a transformer of 5 k.v.a., or less, rated capacity.)

1. A monthly charge made up of the following items:

Item A. Sixty cents (60 cents) to cover the meter expenses, billing, etc.

Item B. A service line charge of one-half cent (½ cent) per foot of service line measured from the center of the highway, when the rural distribution line is located on a highway, or from the said line when located on a right of way owned by the company. A service line shall consist of the wires, poles, and other necessary accessories, connecting the company's rural distribution line with the consumer's meter loop, whether the transformer is located on the company's rural distribution line or on the consumer's property.

Item C. A transformer charge obtained from Table I for the

(Continued on page 240)

The Value of the Distribution of Surplus War Explosives*

By Geo. R. Boyd

Mem. A.S.A.E. Senior Drainage Engineer, U. S. Department of Agriculture

FOR the past four years the U. S. Department of Agriculture has been engaged in re-working the explosives and ammunition which were declared surplus at the end of the world war so that they could be used as commercial explosives. These re-worked explosives have been distributed to various departments of the federal government, to state highway commissions and to farmers for agricultural blasting. During this time there has been distributed for agricultural use 10 million pounds of picric acid, 14 million pounds of an explosive which we called "sodatol," and about 11 million pounds of another explosive called "pyrotol." In addition to these explosives about 16 million blasting caps have been distributed to the agricultural users of the explosives. The Government made no charge for the explosive ingredients themselves but the consumers were charged with the costs of preparation and the freight. The only changes made for the blasting caps were the transportation charges.

There is no doubt but that the savings secured to farmers by the use of this salvaged material rather than commercial explosives have been very large, but to make an estimate of the total amount so saved is a very difficult thing. In the first place, the delivered cost to the farmer of the government explosives is conjectural because a large proportion of these explosives were shipped to some central point and reshipped from there in less than carload lots, and there is no way in which we can arrive at the amounts so reshipped nor the amount of freight charges paid on them. Roughly, it is likely that the average delivered cost of the government explosives has not been more than 9 cents per pound, but this is only an approximation. On the other hand, when we come to consider the cost of an equivalent amount of commercial explosives, more difficulties are encountered. Commercial explosives of the same kind and strength are variously priced by the manufacturers according to the amounts purchased at any one time. Should we use the manufacturer's carload lot price which the farmers could have obtained had they pooled their orders in the same way that they have pooled their orders for government explosives, or should we use the small lot price which the farmers would have had to pay had they bought individually from the manufacturers? Or, should we use the retailer's price which is what the farmer would have had to pay had he purchased commercial explosives in the way he usually does? Then, too, the price of commercial explosives depends upon the grade and kind; shall we use the price of the kind and grade which we believe to be best for the work which is to be done, or shall we use the price of that kind and grade which is ordinarily used in the different localities for that kind of work? There are perfectly good reasons for using any one of these prices, but to be on the safe side, to underestimate rather than to appear to overestimate, we have used the manufacturer's carload price on the cheapest kind of commercial explosives which can possibly be used for agricultural work. On this basis the average country-wide price during the period of the distribution of an equivalent amount of commercial explosives would not be less than 17 cents per pound. On this basis, then, the saving would be the difference between 17 and 9 cents which is 8 cents per pound, and on the total amount of 35 million pounds would be $2,800,000. The savings to the distribution of the blasting caps probably amounts to $160,000, so that the smallest estimate which can be made of the total savings secured to farmers by this work will amount to almost $3,000,000. If the retail price of commercial explosives, that is, the price which the farmer usually pays, had been used the savings would have been several times this sum.

While these savings are large, and while they were made for the farmer at a time when the agricultural industry was in such poor financial condition that every penny saved for the farmer seemed as big as a dollar does under ordinary conditions, I believe that other benefits, more important and of more permanent value, have been secured by means of this distribution and by the work done in connection with it. The exact amount of our estimate of the cash savings is of little importance since we are unable even to approximate the amount of these greater benefits which are intangible and cannot be evaluated in dollars and cents.

We do not know exactly how these explosives have been used, how much have been used on farms which are, at least in part, in cultivation, nor what part was used in making new farms from raw land, but I believe that more than 95 per cent of it has been used on farms which were already under cultivation on farms which were homes and on which the farmer was trying to make a living. My estimate is based on general knowledge of the uses of these explosives in the various parts of the country rather than upon definite information. We have secured very little data upon this phase of the uses of these explosives, but we hope and expect to get more as opportunity arises. Last year the land clearing division of the University of Wisconsin carried on a survey which indicates that about 7 per cent of the sodatol used in 1923-24 was used on farms less than three years old. If this figure is correct for Wisconsin it is entirely reasonable to suppose that for the entire United States the percentage used on what might be called "new farms", i.e. farms which have been carved out of the wilderness in the last three years, is very much less, since there is more land available in this section for such pioneer work than in most of the other states. In this Wisconsin survey we also find indications that farms from 10 to 15 years old used more sodatol than was used in any other 5-year period in the age of farms and now. I hold no brief against the bringing of new lands into cultivation nor do I wish to limit or decry the use of surplus war explosives by the present-day pioneers, for I realize that their need for these explosives is probably greater than in the case of the older farmers who are more able to pay the price asked, but the point I wish to make is this: Almost none of these explosives have been used as an inducement to get new settlers to go upon cutover land, and, conversely, almost all of it has been used in making farms already in cultivation more economical units.

Almost all of the 35 million pounds of explosives—a freight train 15 miles long would be required to carry them—have been used in removing stumps and stones from cultivated fields, in squaring up irregularly shaped fields, and in adding a few more cleared acres to farms which did not have enough land cleared for economical operation. Happily these improvements are permanent ones for ordinarily stumps do not come back in cultivated fields, not if they are blown up with government explosives. A farmer who is trying to farm among stumps or rocks, or in irregularly shaped fields, or without enough cleared land to feed his necessary livestock is working under a handicap which only he can remove. No marketing system, no cheaper freight rates, no agricultural legislation can put him on a real competitive basis with his neighbor. He cannot take full advantage of his opportunities until he has his lands in best possible shape to produce crops. But these improvements are permanent, when

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once done they are done forever. Literally hundreds of thousands of farmers all over the country have so improved their lands by using these explosives. One way to calculate the resulting benefits in dollars and cents is to capitalize the annual savings due to the improvement. To do so is an almost impossible task but I am sure the total figure would make the national debt look like small change. Another way is to determine the increase in the value of the land due to the removal of the stumps, which, also, is no easy matter. A federal farm loan bank appraiser in the South Atlantic states says that he adds one hundred per cent to the loan value of cultivated fields when the stumps are removed, and, because of the industry and good business judgment shown by the farmer in getting rid of the stumps, he adds another one hundred per cent to the appraised valuation of the land. Although I am not one of those who seem to believe that the American farmer can be saved only by providing him with more credit so that he may get still further in debt, I do not think we have done a considerable service if we have tripled the loan value of hundreds of thousands of acres of farm land.

It is true that a considerable part of this work would have been done had there been no surplus war explosives, but reports from every state convince me that the government explosives have been a very great incentive in interesting the farmers in improving their lands. We have often received reports to the effect of "more land has been cleared of stumps in this country this year than has been cleared in 40 years." The stumps have been there all that time interfering with cultivation, taking up good farming space, breaking plow-points and furnishing a rooming house for boll weevils and other insects. Explosives and other means of stump removal have been available all the time. There have been many prosperous periods when the farmer was better able to raise the money for removing the stumps than he has been during the past four years, but the stumps remained in the field until the surplus war explosives came along and the need for them and the advantages to be gained by their use were brought forcibly to the farmers' attention.

This brings us to a discussion of the value of the educational work which has been done in connection with the distribution of these explosives. From the beginning the U.S.D.A. Bureau of Public Roads has insisted that such work be done wherever there was sufficient demand for the explosives to justify it. When the distribution started there were three states doing extension work in land clearing. (That term "land clearing" is a misnomer as this work is not land clearing in most states, but is rather the improving of land conditions, the removal of any obstacles to good cultivation. Only for want of a batter term do we continue to speak of this work as "land clearing" and the men who are engaged in it as "land clearing specialists.") These three states have continued and developed their work along this line, and we now have fourteen other states employing land clearing specialists, either whole or part time. The educational work done by these specialists consists not only of bringing the farmers to a realization of the necessity for better cultivating condition and of demonstrating the safe and economical way of using explosives, but it has broadened out to take in all closely connected problems. That such educational work is of value cannot be doubted. It must be valuable to the farmers or they would not evince the interest in the work which they do. It is no uncommon thing to see from sixty to one hundred men attending a demonstration even in communities which have been long familiar with the use of explosives. Mankind has been clearing land ever since Adam's time and many farmers have been wrestling with stumps and stones all their lives, but there are still things about it which are unknown to many and which can be taught with benefit to all. This is especially true in the use of explosives where some precaution insisted upon a demonstration may prevent the forming of a careless habit which would have taken its toll of human lives.

Considered solely as an extension project the distribution of these explosives has been quite successful. The directors of agricultural extension of all the states which have cooperated with us have individually expressed themselves as being pleased with the results obtained. I am very glad to be able to say that the county agents, to whom any success we may have had is largely due, are all enthusiastic about it in spite of the heavy burdens it lays on their shoulders. Reports made to us indicate that this work has been of great assistance to the extension service as a whole by bringing it into contact with many farmers never reached before and by strengthening and broadening its influence and prestage.

And now, what more can we do to add to the value and benefit of this distribution through the remaining period in which these explosives will be available? I, for one, am not satisfied with the benefits already obtained. Without taking time to go into details, I think we should devote more time and thought to the educational side of this distribution which, to my mind, is of such great importance. Essentially what we are doing is this: We are furnishing the farmers in each state with thousands of dollars worth, and in some states hundreds of thousands of dollars worth, of a potentially dangerous material. It is furnished in small amounts to thousands of farmers in each state and probably interests more individuals than any other extension project. Provision is made for the collection of a fund with which the state extension service agrees to do educational work. In view of these facts, are we not justified in asking that each state use its utmost endeavors in giving instructions in the safe and efficient handling of explosives? Education in safety methods is necessary not because of the nature of these explosives but simply because all explosives are dangerous if handled carelessly, and education on efficient use is necessary because experience has shown that unless such educational work is given the farmers will not receive the full benefit which they should obtain. The concensus of opinion is that the well-planned, well-advertised field demonstration is the best method of teaching both these subjects, but lectures, bulletins, articles and newspaper publicity are all useful.

If we are to receive the greatest possible benefit from this work, each state should make a study of its own individual problem of improving the condition of cultivation. In order to lay a broad foundation for this work, in order to plan ahead, first, find out what your state's problems are and then check up what you are doing to see if you are applying the proper remedy. Find out how many stumps or stones can profitably be removed from an acre for the various kinds of farming carried on in your state. Find out how many cleared acres are necessary or advantageous for the different types of farms. Find out the best and cheapest methods of doing all the necessary operations from brushing to seeding. Some or all of these projects may require cooperative effort with various agencies while others will require some time for their completion, but I believe that such time and effort will be well spent. Then after you have your facts you can see to it that your allotment of explosives is used only where it serves an economic need and in such a manner as to secure the best results and the greatest benefits.

Agricultural engineering is both agriculture and engineering. It is just as much one as the other. It is the application of engineering in its various branches, as civil, mechanical, electrical, etc., to agriculture. It is just as much agriculture as are animal husbandry, agronomy, horticulture, etc. Moreover, it is second to none of these in importance in the development of agriculture.

Research in Agricultural Engineering

A department conducted by the Research Committee of the American Society of Agricultural Engineers

Agricultural Engineering at the Experiment Stations *

By R. W. Trullinger

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AGRICULTURAL engineering, as a relatively new subject, has passed through all the preliminary stages of general testing and experimenting at the agricultural experiment stations, and the work is now being gradually narrowed down to a consideration of very definite and in some cases rather specialized problems based upon specific agricultural requirements. While much miscellaneous testing of a superficial or very general nature is still going on, there is a growing tendency to bring such projects to a close as soon as their usefulness, in providing a background for the pursuit of specific lines of inquiry, is ended.

Since the problems in agricultural engineering originate from the advancement of specific agricultural requirements, which available engineering knowledge is unable to meet, the work has of necessity developed quite definite cooperative aspects. This has naturally tended to reduce sharply the total number of projects in the subject at the stations, through the weeding out or termination of those of a general or indefinite nature, but has resulted in a gradual increase in projects of research grade. In round numbers, there are now about two hundred twenty active projects in agricultural engineering at the stations, according to most recent advices, and in indeterminate number of independent projects at certain of the state agricultural colleges.

FARM MACHINERY AND FARM POWER

The project lists show sixty-nine active projects in farm machinery and farm power at the stations. Of these, thirty-six are devoted to farm machinery and thirty-three to farm power.

Farm Machinery. Of the thirty-six recorded farm machinery projects at the stations, ten are rather general and indefinite, including such matters as economic studies of farm tractors and comparative tests of different types of machinery. The remaining twenty-six projects are largely of research grade and are distributed among thirteen stations. In addition it is known that several farm machinery projects of research grade are in operation at certain state agricultural colleges independently of the experiment station lists.

The projects at the experiment stations and colleges, while dealing with numerous specific phases of the farm machinery question, some of them closely related, emphasize the primary importance of more extensive and fundamental studies of the nature, functions and control of soil colloids, with particular reference to their influence on the physical factors of soil which control tillage and traction and the design of tillage and traction machinery. This is brought out strongly by work in progress at the Alabama and California stations on the properties of soil governing friction between the soil and metal surfaces and the specific evaluation of the physical properties of soil governing tillage and traction, and at the Iowa, Nebraska, California, Illinois, Missouri and Montana stations on the soil factors governing the draft of plows and other tillage machinery. In this connection the importance is also emphasized of cooperatively establishing optimum standard degrees of tilth for individual crops in different soils and of elucidating and controlling the colloidal and other properties of soils governing the production and maintenance of such tilth standards, in order to provide practical objectives for studies of tillage methods and tillage machinery development. The studies at the California and Nebraska stations along this line are especially noteworthy and indicative.

A second outstanding indication of the work in progress on farm machinery at the stations is the importance of the fundamental development and standardization of the different belt driven and field farm machines, other than tillage machinery, on the basis of the perfection of detail as a preliminary to the perfection of entire machines to meet previously conceived, specific agricultural requirements. This is indicated by studies made at the Wisconsin and Illinois stations on silage cutters and blowers and other belt driven machinery, at the Illinois and Washington stations on threshing machinery, at the California station on weed destroying, grain dusting, and almond harvesting machinery, at the Iowa and Illinois stations on milking machines, and at the Illinois station on seed cleaning machinery.

The specific development of certain details of tractors to meet the unusually severe conditions and requirements of agricultural field and stationary practices is also of prominent importance. The studies at the California and Alabama stations of the factors governing the removal of dust from the intake air of tractor motors, at the California station of the factors governing the wear of bearings in tractor motors, at the New York (Cornell) station on cooling, at the Colorado, California, and New York (Cornell) stations on lubrication, and at several other stations on the adaptation and standardization of tractor belt pulley speeds to meet the operation requirements of belt driven machinery place emphasis on the importance of extending the studies of tractor details along more specific agricultural lines.

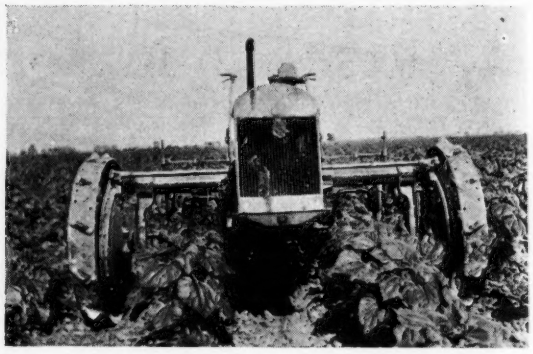
Farm Power. Of the thirty-three farm power projects at the stations, twenty-six are devoted to the application of electricity to agriculture and five are devoted to isolated hydro-electric power plants and the development of windmills to generate electric power by harnessing the wind. These last are at the Iowa, Minnesota, and Indiana stations. The Iowa station is also engaged in a special cooperative study of the horse as a motor.

The application of electricity to agriculture seems, however, to be one of the most important farm power problems at this time, as is indicated by the fact that twenty-six stations are either now engaged in or are planning studies of certain phases of this subject. In addition, it is known that several state agricultural colleges are interested in this subject, although the work has not as yet been taken over by the experiment stations.

While there is an almost universal demand for electric service by farmers, the present profitable agricultural uses of electricity do not consume sufficient power to make the proposition a paying one for either the farmer or the central station. The problem in a nutshell is to increase the profitable agricultural use of electricity to an amount which will also be a profitable matter for the central stations. This involves fundamental research in agricultural engineering which will eventually require cooperation with practically every recognized branch of agriculture.

The preliminary phases of this work require surveys of

*1924-25 report of the A.S.A.E. Research Committee.



These two pictures show H. H. Doughty, a Junior Member of A.S.A.E., cultivating sunflowers during the summer of 1924. He states that this year (1925) the rainy weather kept them out of the field until the corn was large and grassy, but then they ran the motor cultivator from about 4:30 A.M. until 7:30 P.M. for several days and soon had the corn in excellent shape. Farmers around them, who did not have motor cultivators, did not get their corn cultivated and many horses were killed in the attempt. Mr. Doughty has cultivated from ten to thirty acres a day with the machine shown in the picture

power requirements of agricultural processes and analytical studies of processes to determine lines along which the agricultural use of electrical energy can be profitably developed by research procedure. In this connection the U.S.D.A. Office of Experiment Stations has indicated at least a dozen specific lines of research, with the objective of building up a profitable electrical load. Several of the states, notably the Alabama, California, Iowa, Minnesota and Oregon stations, are either now engaged in fundamental studies of specific phases of the subject or are planning to do so shortly. The majority of the stations interested are already experimenting with the use of electricity for different types of belt work. The study made by the Office of Experiment Stations indicates the possibility of extending the use of electricity in dairy, animal husbandry, home economics, poultry raising, and agronomic processes.

FARM BUILDINGS AND STRUCTURES

The work in farm buildings and structures at the stations is advancing to a point where the quite limited utility of broad general projects on the subject is being recognized to a considerable extent. It is being brought out in the work at more than a dozen stations and at several state agricultural colleges that many of the problems in farm structures requiring engineering treatment present conditions of a very special nature and offer opportunities for fundamental investigations specifically adapted thereto.

Everything indicates that the ventilation of animal shelters including poultry houses is becoming a very important problem. Active projects are listed for the New York (Cornell), Nebraska, Iowa, Kentucky, New Jersey, Minnesota, Wisconsin and Pennsylvania stations.

The available knowledge of fundamental principles upon which to base the development of rational and efficient ventilation systems for animal shelters is, however, quite limited. The importance of sincere attempts to so evaluate the factors of ventilation as to maintain the physiological characteristics of the animals concerned at an optimum is thus evident. This would indicate that ventilation studies should be conducted under controlled conditions with animals, the health, comfort, economy and productiveness values of which are known with a reasonable degree of accuracy as judged by suitable standards. The necessary cooperative features of this work are thus quite evident and the employment of methods and apparatus, similar to those used in respiration calorimetric studies, would seem to logically follow. This is emphasized by the work at the Iowa station on the ventilation of poultry houses and at the Pennsylvania station on the ventilation requirements of farm animals.

The development of structures for the storage of crops is also quite an important problem in a number of localities. The studies of potato storages at the Michigan station, of fruit and vegetable storages at the California and Oregon stations, of apple storages at practically all the stations of the North Atlantic states, and of sweet potato and other root storages at several of the stations in the southern states indicate the uniformly widespread significance of the problem. The cooperative features of this work are also obvious, since the importance of a careful consideration of the heat and ventilation requirements of the crop concerned and of its behavior under storage conditions as a basis for the development of storage buildings is strongly emphasized by the work in progress.

Another important problem of the more or less emergency type, involving a combination of storage and ventilation principles, is the curing and storage of green hay and soft corn and wheat. As indicated by the work at the Illinois and Iowa stations and at agricultural institutions in Europe, this is a broadly cooperative problem involving the development of drying and curing apparatus as well as proper storage.

The importance of the specific development of building designs to meet the requirements of individual animal types, in addition to the provision of proper ventilation, is also indicated by the existence of several projects on dairy and beef-cattle barn and poultry house design. The development of cheap and efficient silo types is also of considerable importance in certain localities, notably the northern prairie states.

Studies to develop the design of barn and other building frames along economical as well as structurally sound lines are quite important, as is indicated by work at the Iowa and other middle western stations and agricultural colleges. Farm building frames are being found faulty in many respects, such as improper and uneconomical distribution of material, overloading of members, poorly designed joints, uneconomical sections, poorly designed anchorages, and plain waste of material. The importance of a concerted effort to provide safe and durable as well as economical structures is thus plainly evident.

IRRIGATION

Practically every station in the irrigated sections has active projects in some phase or other of irrigation, there being at least forty-six projects distributed among these stations, including the prairie rice-growing sections. In addition the Illinois station is studying the overhead irrigation of strawberries and the Tennesee station is interested in the irrigation of market garden crops.

Almost every conceivable phase of irrigation is receiving some attention at the stations, from the purely engineering phase of water measurement to the more or less agronomic phase of determining duty of water for different crops. The latter extreme is receiving the most attention, there being eighteen duty-of-water projects at seven stations. The California station is the leader in this work.

Underground water supplies and pumping for irrigation are also important subjects, there being eleven related pro-

jects at six stations. It is significant to note that there is but one project on the principles of soil moisture in relation to irrigation.

Everything indicates the importance of developing the more fundamental aspects of these lines of irrigation study. Exact determinations of the duty of water for different crops and studies of the factors governing the capacity of different soils for the absorption, retention, and supply of moisture to meet the specific requirements of individual crops are much needed to provide a basis for the development of irrigation practices and the design of irrigation structures. This is being brought out especially by work in progress at the California station and by work being planned at the Idaho station. Cooperation between stations on phases of this work of common interest seems also logically in order.

The development of rice irrigation practices in the prairie sections where the water supply must be obtained mainly by pumping is also assuming considerable importance as indicated by the work being planned at the Arkansas station. Here also studies of the exact requirements of different rice varieties for moisture and heat, and studies of the capacity of different soils to provide the proper environmental conditions, are needed to provide a basis for the development of rice irrigation practices and equipment.

DRAINAGE

There are fifteen projects at ten stations on different phases of drainage, and it is well known that several of the state agricultural colleges are experimenting with drainage independently of the experiment stations. The majority of these projects are of a service nature and consist mainly of the installation of preconceived drainage systems and the observation of subsequent results without the use of any standards for comparison. Very little work of a fundamental nature seems to be in operation on the subject beyond a few studies of run-off.

Apparently there is little basis for drainage engineering procedure beyond tradition and certain quite limited data obtained in an empirical manner. Cooperative studies of the optimum environmental conditions for individual crops in both humid and arid soils with reference to moisture and temperature, and studies of the nature and control of the factors governing the absorption, retention and movement of moisture in soils, especially in the presence of an excess thereof, are of obvious importance to provide a basis for drainage practices and the design of drainage systems. More extensive studies of the physico-chemistry of soils with reference to the development of materials for drainage structures are also important, as indicated by the work at the Minnesota and North Carolina stations.

FARM WATER SUPPLY, SEWAGE DISPOSAL AND SANITATION

There are eight active projects at as many stations on farm sewage disposal and three projects at three stations on farm water supply. It is also known that several of the agricultural colleges are experimenting along these lines independently of the stations. The majority of these projects are either comparative or merely service tests of different preconceived types of sanitary apparatus and there appears to be very little work of a fundamental nature in operation on the subject, with the exception perhaps of that at the New Jersey station on the biology of sewage disposal and at the Illinois station and the Kansas State Agricultural College on the fundamental principles of farm sewage disposal as a basis for the design of disposal systems and equipment.

The subject of farm sewage disposal has been agitated for many years, but it has rarely ever received the fundamental study which its importance would seem to merit. It would seem advisable for stations in states having similar conditions to arrive at some suitable standards of sanitary requirement with reference to farm sewage disposal which will indicate the limits of necessary purification for different conditions. This would provide definite standard objectives for sewage disposal studies and the foundations could then be laid for studies of the nature and control of the factors governing the production of the required degree of purity of sewage of the type encountered on different farms. This general procedure is being followed to a certain degree in studies of the purification of dairy and creamery sewage and its extension to cover all types of rural sewage seems justified.

LAND CLEARING

The work in land clearing at the stations has developed rapidly in recent years from a miscellaneous matter to one of prime importance, especially in the northern lake states and in the southern and northwestern timbered areas. There are now at least fifteen land clearing projects at the stations in the localities mentioned.

Owing to the nature of this work, it has rarely if ever been of a research grade, consisting mainly of comparative tests of land clearing methods and apparatus therefor. Consequently most of the results obtained have been of limited local application.

More recently, however, there has been a tendency at some of the stations to develop land clearing processes and apparatus more fundamentally. With this in view, studies of the power requirement for stump removal of both a steady and impact nature are being planned which would be based upon the volume weight of stumps and the stable and impact strengths of roots in tension in different soils. This procedure has already been used by the British Ministry of Agriculture with considerable success in the economic development of machines and explosives for stump and stone removal, and it would seem that some such fundamental procedure might well be more generally adopted for the further development of land clearing processes in this country. The economy and efficiency of cooperative efforts by interested stations would seem to be obvious.

MATERIALS OF CONSTRUCTION

Materials of construction is another subject which has developed quite recently from a minor matter to one of prime importance in its specific relationship to agricultural engineering practices. There are about twenty-two active projects quite uniformly and widely distributed among as many as a dozen stations, and several state agricultural colleges are also engaged in independent work on different phases of the subject.

The subject of durability and preservation of structural timbers, particularly fence posts, seems to be commanding the most attention, there being fourteen active projects on this subject alone at the stations. It would seem that a more fundamental consideration of exactly what is required of fence posts in different types of farming would give definite purpose and direction to much of this work and provide a basis for profitable cooperation between interested stations. The same procedure would also seem to be applicable to the development of roofing and other structural materials to meet the specific requirements of agricultural structures.

CONCLUSION

This review of the work in agricultural engineering at the stations emphasizes the importance of more thorough consideration of the exact requirements of agricultural practices to provide definite purpose and direction for engineering investigations. It also indicates a still too frequent tendency to limit agricultural engineering work to comparative tests of the ability of different available engineering apparatus and methods to meet agricultural requirements for engineering manipulation when the development of new principles or the fundamental modification of old ones are really necessary.

Cooperative efforts by groups of stations on problems of common interest to secure collective agreements on objectives and plans of procedure, to prevent duplication of effort and to insure the allocation of the different phases of the work where they can best be handled would also seem to be of the utmost importance.

Agricultural Engineering Digest

A review of current literature on agricultural engineering by R. W. Trullinger, specialist in agricultural engineering, Office of Experiment Stations, U. S. Department of Agriculture

Electrification of Rural Districts in France (Electrical World, 85 (1925), No. 12, pp. 605, 606).—A brief account is given of the electric service in the towns and more important rural localities of the Department of Loire Inferieure in France.

Paint Law and Regulations (North Dakota State Food Commr. and Chem. Bul. 8(1925), pp. 45-68).—The text of paint and varnish laws and regulations for the State of North Dakota are presented, together with the results of analyses of thirty-seven samples of paints and varnishes collected for inspection in the state since 1920.

Use of Electrical Energy in the Smaller Rural Industries [trans. title] (Nuovi Ann. Agri. [Italy], 4(1924), No. 3, pp. 489-565).—This is a somewhat detailed discussion of the economic and engineering features of the application of electricity to Italian farming, special reference being made to the requirements for irrigation pumping and plowing.

Nail-Holding Power of Cinder Concrete (Concrete [Detroit], 26 (1925), No. 4, p. 144).—Tabular data on the holding power of wire nails in cinder concrete building blocks as compared with wood are briefly reported.

The Mechanics of Building Construction, H. Adams (London and New York: Longmans, Green and Co., 1923, new ed., pp. XI+240, figs. 590).—This is the second edition of this book, dealing with the engineering theory and practice of building construction.

Rural Highway Mileage, Income, and Expenditures, 1921 and 1922, A. P. Anderson (U. S. Department Agricultural Bulletin 1279 (1925), pp. 88).—A large amount of data on the subject is tabulated. These data show that on January 1, 1922, the rural public roads of the forty-eight states had a total length of 2,941,294 miles and involved a disbursement of $1,036,587,772 during the year 1921. Of the total road mileage, 387,760 miles had been improved with some form of surfacing when the year 1922 began.

Of the individual states Indiana at the beginning of 1922 had the largest mileage of surfaced roads, a total of 39,857 miles, of which 30,801 miles were gravel. California led the states in the mileage of concrete roads, with 2,613 miles, followed by Illinois with 1,534 miles of this type. Ohio was first in the mileage of brick roads and Florida second, while Oregon was first in mileage in bituminous concrete, followed closely by New Jersey. During the year 1921 a total of 41,171.7 miles of road were improved with some form of surfacing and 34,456.3 miles were thus improved during 1922.

Dairy Engineering, J. T. Bowen (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1925, pp. XIV+ 532, figs. 163).—This volume, one of the Wiley Agricultural Series, edited by J. B. Davidson, is intended primarily to aid those engaged in the production and handling of milk and in the manufacture of milk products, and in the selection, installation, operation, care, and management of the necessary machinery. It contains chapters on definitions and units, steam and steam boilers, boiler settings, boiler fittings and accessories, chimneys, combustion—firing, the steam engine, steam piping and accessories, exhaust steam and its uses, sources of heat loss in small steam plants, the internal-combustion engine, transmission of power, the compression refrigerating system, methods of utilizing refrigeration, insulation, direct-current motors, alternating-current motors, and temperature measurements and control.

Value of Fans in Furnace Heating, C. G. Buder (Journal American Society Heating and Ventilating Engineers, 31 (1925), No. 6, pp. 349-352, figs. 2).—Studies are reported showing that the efficiency of a furnace is increased doubly by forced circulation due to the decreased surface resistance caused by the greater air velocity and to the greater difference in temperature between the furnace and surrounding air. In addition to preventing stratification, the fan helps to insure better distribution to all parts of the building and thus aids in preventing air stagnation.

Water Displacement of Soils and the Soil Solution, J. S. Burd and J. C. Martin (Journal Agricultural Science [England], 13 (1923), No. 3, pp. 265-295, fig. 1).—Studies conducted at the University of California on the subject using three sandy soils and two clay loams are reported, in which it was found that the use of a positive air pressure on closely packed soils decreases the time of recovery and increases the yields of solution obtained by water displacement. Successively displaced solutions of equal electrical conductivity were obtained from each soil. The concentration thus measured was in each case the same as that of the liquid obtained without the use of displacing water.

Concentrations of individual ions in successive portions of displaced solutions were uniform in soils at optimum and at half optimum. There was an inverse proportion between total moisture content of soil and concentration of the displaced solution as indicated by measurements of specific resistance.

When the solution displaced by water from a given mass of soil was used as a displacing agent on another portion of the same soil, the newly displaced solution had the same concentration of electrolytes as the displacing solution. This is taken to indicate that the displaced solution had the same concentration as the solution with which it came in contact in the soil.

Evidence is presented which tends to show that compacted soils become completely saturated during displacement, and that the mechanism of displacement consists in an actual translocation of successive layers of liquid.

Studies of Capillary Rise in Soils [trans. title], C.-V. Carola (Ann. Sci. Agron. Franc. et Etrang., 42 (1925), No. 1, pp. 1-31, figs. 17).—A theoretical discussion of the subject is followed by a report of experimental determinations of the capillary rise in sand soil, very fine sandy silt, silt, clay humus silt, and flinty clay.

The velocity of capillary rise of water in these materials appeared to be regulated by the fineness of the particles, or in effect by the percentage of clay. Capillary absorption proceeded in a manner analogous to that of capillary rise. As the soils varied from pure silt to clay, the action of the clay content depressed permeability and capillary absorption from 0 to 18 per cent.

Farm Water Works and Sewage Systems, T. B. Chambers and M. L. Nichols (Alabama Polytechnic Institute. Extension Circular 80 (1925), pp. 35, figs. 22).—Practical information on the planning of water supply and sewage disposal systems for farms, with special reference to the requirements of Alabama conditions, is presented in this circular.

Tests on Household Septic Tanks, H. W. Clark (Engin. and Contract., Water Works, 63 (1925), No. 6, p. 1250).—Analytical data from tests of two household septic tanks are presented and discussed with reference to the design of the tanks.

Ground Water in Santa Clara Valley, California, W. O. Clark (U. S. Geol. Survey, Water-Supply Paper 519 (1924), pp. VII+209, pls. 19, figs. 20).—This report, prepared in cooperation with the department of engineering of the State of California, deals with the ground water of an area of 380,000 acres extending southeastward from San Francisco. It has been found that the ground water of Santa Clara Valley is on the whole satisfactory for both domestic use and irrigation. A few wells have water that is not considered good for domestic use or is said to be injurious to plants. The largest group of such wells is in a small area with meager water supply. All the wells of this locality are of small yield, and many of them can be pumped dry with an ordinary windmill.

Cylinder and Engine Lubrication, A. L. Clayden (Journal Society Automotive Engineers, 17 (1925), No. 1, pp. 58-61, figs. 2)—Laboratory tests are reported of an engine equipped with a steam cooling system, the object being to study the effect upon dilution of high cylinder wall temperatures.

The results showed that a sharp reduction in dilution occurred as the boiling temperature was reached, and that the amount of dilution at temperatures of 212 degrees Fahrenheit or more was much less than would have been anticipated at lower temperatures. It is pointed out that high cylinder temperatures reduced dilution to a negligible quantity without introducing any apparent disadvantages. The fact that the elimination of dilution will inevitably introduce lubrication troubles, due to the higher viscosity of oil which will prevail, is emphasized, and various methods by which oiling systems can be modified so as more nearly to approach the ideal condition are suggested.

Irrigation Experiments [at the Umatilla (Oreg.) Reclamation Project Experiment Farm], H. K. Dean (U. S. Department Agriculture, Department Circular 342 (1925), pp. 20-22).—Size, length, and width of border experiments and lysimeter investigations of the moisture relations of sandy soils and the effect of crops on these relations are briefly reported.

In the length of border experiments it was found that the quantity of water applied annually and the depth per application required increased directly with the length of the run. The width of border experiments showed that 20 and 25-foot borders were very economical of water, and that the 30 and 35-foot borders did not require excessive quantities.

Duty-of-Water Experiments [at the Umatilla (Oreg.) Reclamation Project Experiment Farm, 1921], H. K. Dean (U. S. Dept. Agr., Dept. Circ., 342 (1925), pp. 13-16).—Data from duty-of-water experiments with alfalfa on soils varying from very coarse to very fine sand are briefly reported. These indicated a relation between the type of soil and the water requirement. The yield per unit of water applied to the land was greatest on the finest soil and ranged in order from the finest to the coarsest soil. Each unit of water applied to the very fine sandy soil gave a return in tons per acre foot which was 14 times greater than from the same application on very coarse sandy soil, 2.1 times greater than on coarse sandy soil, 2.9 times greater than on medium sand, and 1.6 times greater than on fine sand.

Engine-Starting Tests, J. O. Eisinger (Journal Society Automotive Engineers, 17 (1925), No. 1, pp. 52-57, figs. 18).—Studies conducted at the U. S. Bureau of Standards on the influence of various

factors on the starting of an internal-combustion engine are reported.

The results showed that, within certain limits, the richness of the mixture determines the number of revolutions that must be made before an explosion is obtained. Differences in distribution of the mixture were found to be negligible. It was shown very definitely that an advance of approximately 35 degrees in the spark gave a much shorter starting time than one of 10 degrees, and somewhat shorter than one of 50 or 80 degrees. Retarding the spark beyond top-center gave even poorer results.

It was also shown that the vertical distance through which the fuel must be lifted may be important. It was found desirable to locate the carburetor jet so that the vertical distance through which the fuel must be lifted will be at a minimum.

It was found that the problem of starting in cold weather does not consist of merely getting fuel into the cylinder, but that the quantities of fuel required may be very different for different jacket-water temperatures. Choking was found to give somewhat better results than throttling, as it reduced the pressure throughout the intake system instead of in the manifold alone.

General Physics, E. S. Ferry, (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1923, pp. XVI—812, figs. 601).—The purpose of this book is to impart information and to give training in the methods by which facts are correlated in laws, and these laws applied to the affairs of life. Special attention is given to agriculture, engineering, and general science.

Dairy Barns and Equipment, W. A. Foster and E. Weaver (Iowa Station Circular 93 (1925), pp. 2-31, figs. 22).—The essential and desirable features of dairy barns are discussed from the standpoint of Iowa conditions, and drawings of different structural details are included, together with analytical discussions thereof.

Civil Engineering Geology, C. S. Fox (London: Crosby Lockwood & Son, 1923, pp. XVI+144, figs. 80).—This book, which is in three parts, presents considerable data of use to agricultural engineers. Part 1, on water supply and irrigation, contains chapters on general rainfall considerations, rivers and canals, reservoirs, infiltration channels and wells, and artesian conditions; part 2, on field operations, contains chapters on retaining walls, tunnels and shafts, stability of hillsides, quarrying and mining, and building sites; part 3, on building materials, contains chapters on mode of occurrence of rocks, the principal rock groups, the common rock-forming minerals, the physical properties of rocks, and choice materials.

Portable Apparatus for the Electrical Determination of Soil Moisture in the Field [trans. title], C. Gore (Internatl. Mitt. Bodenk., 14 (1924), No. 1-2, pp. 35-39, pl. 1).—A portable apparatus is described which permits the determination of the soil moisture by measurement of the electrical conductivity. The apparatus is arranged to deal with moisture ranges from 5 to 25 per cent.

The measurement depends upon the fact that the different factors which influence conductivity with the exception of water content are excluded. The quotient of resistance of a constant and a variable current in the same soil sample is constant and proportional to the specific conductivity.

With uniform temperature and water content the soil resistance decreases with an increase in the density of stratification, but remains constant when the density of stratification exceeds a pressure resistance of 3 kilograms per square centimeter (42.6 pounds per square inch).

The Septic Tank, R. R. Graham (Ontario Department Agriculture Circular 46 (1925), pp. 8, figs. 5).—A description is given of a septic tank adaptable to Ontario conditions together with plans and specifications for its construction and installation.

Studies on the Industrial Dust Problem—II, A. Review of the Methods Used for Sampling Aerial Dust, L. Greenburg (Public Health Reports [U. S.], 40 (1925), No. 16, pp. 765-786).—Several methods and the accompanying apparatus are described.

The Volume-Changes Associated with Variations of Water Content in Soil, W. B. Haines (Journal Agricultural Science [England], 13 (1923), No. 3, pp. 296-310, figs. 7)—In a contribution from the Rothamsted Experimental Station a new and simple method of measuring the shrinkage of moist soil on drying is described, which at the same time gives values for the pore space and specific gravity of the soil. Diagrams for a number of diverse soils are given, illustrating the character of soil shrinkage. The shrinkage is shown to take place in two stages in both of which there is a linear relationship to the moisture content. Tentative explanations of these two stages are advanced based on the colloid coating hypothesis and confirmatory experiments are described. By means of the method the effect of alternate getting and drying of soil in producing good tilth is illustrated.

The Maximum Water-Retaining Capacity of Colloidal Soils; The Interpretation of This and of Certain Other Soil Moisture Constants, F. Hardy (Journal Agricultural Science [England], 13 (1923), No. 3, pp. 340-351).—In a contribution from the Imperial Department of Agriculture of the British West Indies, an investigation into the applicability of the Briggs-Shantz relationship connecting maximum water retaining capacity with hygroscopic coefficient to soils containing appreciable amounts of colloidal matter of different specific nature is reported.

The results indicated that the Briggs-Shantz equation $M=4.3_h+21$, in which **M** is the maximum water retaining capacity and **H** is the hygroscopic coefficient, while generally applicable to soils the colloidal properties of which are not marked, yields values for the calculated maximum retentivity constant that are in considerable deficit of the experimentally determined values when applied to highly colloidal soils containing siliceous colloids. This result is believed to be due mainly to the marked volume expansion exhibited by these soils when wetted.

In the case of red lateritic soils, in which the colloid content is composed mainly of alumina hydrogel and ferric oxide hydrogel, the calculated values for the maximum retentivity constant were, on the contrary, found to be in excess of the estimated values. These soils, though highly colloidal, exhibited a remarkably low volume expansion on wetting.

In the siliceous West Indian soils examined, the vesicular coefficient appeared to vary between 4.9 and 3.3, with a mean value of 4.2, whereas for red lateritic soils it varied between 3.5 and 2.4, the lowest figure being given by the most typical of these. The low vesicular coefficient of the colloidal material that characterizes the lateritic soils is believed to account partly for the discrepancy between the calculated and estimated values for the maximum retentivity constant.

A new formula connecting maximum water retaining capacity with the total bound water and with free interstitial film water was also tested. In this formula total bound water is represented by the moisture content of the soil at the point of stickiness, it being believed that at this stage the soil colloids are completely saturated with water. The results obtained indicated that this formula also fails to yield results in concordance with experimental data, except in the case of lateritic soils for which it seemed to apply quite closely. The main reason for failure in the application of the new formula to colloidal soils containing siliceous colloids again appeared to be the marked volume expansion which these soils exhibited when wetted. Results in general agreement with those obtained with soils containing inorganic colloids were yielded by two highly humic soils.

The bearing of the theories and results discussed on the significance of other soil moisture constants, namely, the wilting coefficient, the moisture equivalent, and the critical moisture constant, was examined. The importance of recognizing specificity in soil colloidal material is emphasized.

The Physical Significance of the Shrinkage Coefficient of Clays and Soils, F. Hardy (Journal Agricultural Science [England], 13 (1923), No. 3, pp. 243-264).—Studies conducted at the West Indian Agricultural College on the significance of the shrinkage coefficient of clays and soils are reported.

It was demonstrated that soils of similar colloid content and belonging to the same geological type, but exhibiting different degrees of aggregation, possess similar shrinkage coefficients. The hypothesis accepted to explain soil shrinkage was based on the belief that colloidal gels possess a reticulate structure. At the point of saturation a hydrogel probably contains water in two phases, the first phase of which is absorbed in the walls of the gel the second of which fills the vesicles of the gel and is a crystalline phase. It was demonstrated that shrinkage in clays and soils is due solely to loss of vesicular water. It was further found that accurate values for the hygroscopic coefficient of soils cannot be calculated from observed shrinkage coefficients.

Variations in the shrinkage coefficients of soils of similar colloid content but belonging to different geological types are considered to be probably due to specificity in soil colloids. This manifests itself chiefly in differences in the ratio of absorbed water to vesicular water. Red lateritic soils rich in alumina hydrogel appeared to possess relatively low vesicular water contents, and in consequence exhibit low shrinkage coefficients.

The physical basis of the assumption that the water content at the point of maximum plasticity represents the imbibition capacity of a clay or soil is discussed in the light of modern theories of plasticity, and is provisionally accepted as marking an important stage in the water relations of clays and soils.

An extensive bibliography is included.

The Effect of Moisture on Concrete, W. K. Hatt (U. S. Department Agriculture, Public Roads, 6 (1925), No. 1, pp. 14-23, figs. 19).—Investigations conducted by Purdue University in cooperation with the Bureau of Public Roads are reported, the primary purpose of which was to measure the maximum warping and surface deformation of a concrete road slab resulting from nonuniform distribution of moisture, as a basis for measuring possible initial stresses.

The results showed that the strength of concrete varies with its moisture content. Apparently the strength of saturated concrete will be from 80 to 85 per cent of that of dry concrete. The thermal coefficient of expansion of concrete was found to vary with the temperature and the moisture conditions. Concrete expanded when immersed in water and contracted on drying, the degree of change of length varying markedly with the characteristics of the cement, richness of the mix, the size of specimen, and the conditions of exposure.

Concrete road slabs warped upward at the corners and at the edges when the surface became dry, and also when the bottom absorbed the moisture from the subgrade. Drying the top surface of the slab under observation caused the corners to deflect upward 0.12 inches, and saturating the bottom of the slab caused an upward deflection of 0.2 inches. The tests indicated the presence of an initial stress in the surface of the road slab arising from the warping. A combination of shrinkage from drying and from a fall in temperature was found to produce maximum shrinkage strains.

Best Location for Carburetor Intake, A. H. Hoffman (Journal Society Automotive Engineers, 16 (1925), No. 5, pp. 501, 502, figs. 5).—Experiments conducted at the California Experiment Station to determine the location under the hood of a motor vehicle where the air intake of the carburetor will be exposed to the least dust are reported. The most effective type of dust screen was one of a

coarse hospital gauze stretched over frames set in transverse vertical positions on either side of and above the engine.

Tests of two phaetons and a speed truck, run for less than three miles and following another car on a dusty road, led to the conclusion that in normal cases the best carburetor intake position is on the side of the engine on which the fan blades have a descending motion, about midway between the radiator and the dash, about midway between the side of the hood and the center line of the engine, and about one-third of the distance down from the top of the hood toward the top of the cylinder head.

Air-Cleaners on Trucks in Service, A. H. Hoffman, (Journal Society Automotive Engineers, 16 (1925), No. 2, pp. 249-256, figs. 7).—Tests conducted by the California Experiment Station of the action of air cleaners on eight 3½-ton trucks are reported and discussed.

The results indicated that in a service test involving several uncontrollable variables, no just comparisons can be drawn among air cleaners not differing greatly in efficiency. Frequent changing of crankcase oil and consequent maintenance of higher viscosity was found to reduce markedly engine wear. Placing the air inlet high up and well back under the hood lessened the quantity of dust encountered. It was found that the air inlet should face forward, since a rearward opening acted as an inertia type dust separator.

Final Report on the 1924 California Air-Cleaner Tests, A. H. Hoffman (Journal Society Automotive Engineers, 16 (1925), No. 3, pp. 367-371, 378, figs. 5).—Continuing previous work (Agr. Engin., 4 (1923), pp. 89,109), this report presents the results of the studies from June, 1924, to the end of the year at the California Experiment Station, and includes data from tests of twelve new makes or models of air cleaner not previously tested or not fully tested.

A discovery of outstanding importance was that the quantity of dust inspired by any cleaner or carburetor is greatly reduced if the intake is placed high and faces away from the direction of motion of the vehicle. The cleaners on two 3½-ton trucks with intakes located 46 and 48 inches above ground and facing forward encountered approximately 0.07 and 0.08 grams of dust per mile, respectively, whereas two other trucks of the same make and model and used in the same work, which had no air cleaners but whose intakes were directed backward, encountered much less dust.

The O. A. C. Diagonal Axle Dusting Machine for Treating Wheat for Smut, G. W. Kable (Oregon Agricultural College Extension Bulletin 381 (1925), pp. 7, figs. 5).—This machine is described and illustrated.

Heating of Residences and Small Buildings, A. G. King (Chicago: Domestic Engineering Pubs., 1924, pp. 142, figs. 71).—Practical information on the heating of residences and small buildings, such as cottages, bungalows, and garages, is presented. Chapters are included on heating a cottage by steam, proper main and pipe connections, heating a cottage by hot water, heating a residence by hot water, heating a residence by a vapor system, important details about vapor heating, heating a residence by an air-line system, the proper construction of chimneys, heating a medium-sized garage, heating a private garage, and heating and ventilating small garages.

Allowance for Variations in Temperature at Register Faces for Design of Warm-Air Furnace Systems, A. P. Kratz (Journal American Society Heating and Ventilating Engineering, 31 (1925), No. 6, pp. 336-342, figs. 4).—Studies conducted at the University of Illinois are reported which showed that the distribution of the temperature at the register faces of a warm-air furnace plant is not uniform. This unequal distribution was found to be caused by unequal temperature drops in the leaders and by the unequal distribution of the temperature of the air in the bonnet.

The distribution of the temperature of the air in the bonnet is independent of whether first, second, or third floor leaders are used at the different points, but is determined by the character of the furnace used or by the orientation of the furnace with respect to the plant. It was found in general that the temperature of the air in the bonnet tends to be highest at the rear of the furnace. In designin' a properly balanced warm-air heating plant, account should therefore be taken of the variation of the temperature of the air in the bonnet as well as of the variation in the temperature drops in the several leaders.

Curing Concrete with Calcium Chloride, C. L. McKesson (U. S. Department Agriculture, Public Roads, 6 (1925), No. 1, p. 23).—Tests conducted by the California Highway Commission are briefly reported, indicating that calcium chloride is from 80 to 90 per cent efficient, and that it may be used as a substitute for water curing where water is scarce. Some of the strength appeared to be sacrificed, but the cores showed a minimum average strength of more than 3,000 pounds in the most unfavorable case, thus indicating a fair factor of safety.

The Insulation of Roofs to Prevent Heat Loss and Condensation, W. L. Miller (Heating and Ventilating Magazine 21 (1924), No. 11, pp. 45-49, 61, figure 1).—Data on the insulation of roofs are presented, with notes showing how to figure this work and information on the savings made possible when effective insulation of roofs is applied.

Rural Electric Service Costs

(Continued from page 232)

size of the transformer that would be provided if the consumer were to be served by a separate transformer, except that, when two or more consumers are served from one transformer, and the entire cost of the secondary wiring is covered in the consumer's service line charge, the transformer charge for the size of the transformer used shall be apportioned between them by the ratio that the monthly billing demand of each bears to the sum of the monthly billing demands of those served from the transformer.

TABLE I

Size of transformer —kilovolt-amperes	Amount of charge
1½	$3.10
3	3.40
5	3.90

Item D. A pole line charge determined by multiplying the consumer's monthly billing demand by the value obtained from Formula I for the demand miles of the line, except that during those months in which the meter, transformer and service line may not be installed, fifty cents (50 cents) per kilowatt of monthly billing demand shall be added to the said pole line charge. If the service line is installed the amount shall be increased by the amount of the service line charge, Item B.

Formula I The charge for the demand miles of a line will be determined as follows:

(1) Obtain the product of fifty cents (50 cents) and the demand miles of the line.

(2) Obtain the remainder found by subtracting the product (1) from $15.00.

(3) Divide the remainder (2) by the demand miles of the line; the quotient is the monthly charge for the demand miles.

NOTE: The demand miles will be the sum of the monthly billing demands of consumers served by the line divided by the number of miles of line. The monthly billing demand of a consumer served by the line will be determined as follows:

1 kilowatt for each rural consumer having no device larger than 750 watts.

1½ kilowatts for each rural consumer having a device larger than 750 watts, but not exceeding 2½ kilowatts.

2 kilowatts for each rural consumer having a device larger than 2½ kilowatts, but not exceeding 6 kilowatts.

2½ kilowatts for each rural consumer having a device larger than 6 kilowatts, but not requiring a transformer in excess of 5 kilovolt-amperes.

640 watts for each residence consumer, in a settlement or town supplied from the line, having no device larger than 750 watts.

1.7 kilowatts for each residence consumer, in a settlement or town supplied from the line, having a device larger than 750 watts, but not exceeding 6 kilowatts.

2 kilowatts for each residence consumer, in a settlement or town supplied from the line, having a device larger than 6 kilowatts but not requiring a transformer in excess of 5 kilovolt-amperes.

85 per cent of the monthly billing demand, based on a kilowatt at 100 per cent power factor, of each commercial light and power consumer, in a settlement or town supplied from the line, who does not require a transformer in excess of 5 kilovolt-amperes.

70 per cent of the monthly billing demand, based on a kilowatt at 100 per cent power factor, of any consumer supplied from the line who requires transformer capacity in excess of 5 kilovolt-amperes.)

Item E. A demand charge as follows:

Monthly Billing Demand	The demand charge per month
1 kilowatt where no device exceeding 750 watts is installed	$1.00
1½ kilowatts where a device larger than 750 watts, but not exceeding 2½ kilowatts, is installed	1.50
2 kilowatts where a device larger than 2½ kilowatts, but not exceeding 6 kilowatts, is installed	2.00
2½ kilowatts where a device larger than 6 kilowatts, but not requiring a transformer larger than 5 kilovolt-amperes, is installed	2.50

(NOTE: The demand charges and the monthly billing demand as above determined and the monthly billing demands as determined in Item D are tentative values and are subject to revision when authoritative diversity factor data is available.)

2. An electricity base rate of 2.9 cents per kilowatt-hour for all electricity used in a month.

3. The charges and rates are net. Bills not paid within ten days after rendition shall be increased ten per cent on the first ten dollars and two per cent on amounts in excess of the first ten dollars.

4. The electricity base rate will be increased or decreased beginning with each fiscal year, at the rate of one mill per kilowatt-hour for each 50 cents (or major part thereof) variation in the energy cost per ton from a base energy cost of $4.50 per ton of 10,000 B.t.u. fuel burned during the previous fiscal year. The energy cost per ton of fuel burned shall be obtained by dividing the total fuel, boiler room labor, and water (for boilers) expenses by the number of tons of fuel burned in the company's steam-electric plants. A fiscal year is the period from April 1 to March 31. Should the quality of the fuel burned vary from 10,000 B.t.u., the base energy cost shall be varied in proportion as the fuel burned varies from 10,000 B.t.u.

5. Those desiring service under these rates will be expected to sign Contract Form N. C-82.

Issued by SUTHERLAND DOWS, General Manager

SUPPORTING DATA FOR VALUES IN RATE NO. 61 OF THE IOWA RAILWAY & LIGHT COMPANY

Prepared by W. J. Greene and E. A. Holloway

ARTICLE I

Item A. Urban costs per consumer—

(1) Commercial office expenses (annual)	$ 2.970
(NOTE: This item is obtained from the average costs for forty towns and eight cities with 31,778 consumers with 10 per cent added for general expenses, year 1921.)	
(2) Consumer element of general expenses (annual)	1.061
(NOTE: This item is 15 per cent of the general expenses of the Iowa Railway & Light Company apportioned to the electric department divided by 31,778 consumers, year 1921.)	
(3) Investment expenses on meters (annual)	1.555
(NOTE: This item is 80 per cent of the investment expenses of the meters in forty towns divided by the number of consumers. It was assumed that 80 per cent of the meter expenses varied directly with the number of consumers and the balance with the demand. Value of meters, $62,081.98. Number of consumers, 5,772. Average value, $10.76. Consumer's portion, $8.608. Investment rates taxes and insurance, 1.2004 per cent. Depreciation and maintenance, 8 per cent. Interest or money cost, 7.23 per cent. Total, 16.4304 per cent. Cost per consumer, $1.414, to which add 10 per cent for general expense, year 1921.)	
(4) Additions for extra rural costs—	
Inspection, service, etc.	.500
Extra investment expense for installing meter, 16.4304 per cent of $1.00	.164
Meter shunt coil loss costs (14.89 k.w.h.x1.8 cents)	.268
Total before contingencies and profits	$ 6.518
Contingencies, profits, and factor of safety, 10 per cent	.652
Total annual	$ 7.170
Monthly charge	$ .60

Item B. The following is an estimate of the cost of 150 feet of service line:

50 lbs. No. 6 W.P. copper	$ .20	$10.00
1—30′ 6″ top pole W.R.C.A. Spec. ½″ treatment	8.80	8.80
2—5′ 7″ N.E.L.A. cross arms	.85	1.70
4—28″ braces	.14	.56
4—⅜″ x 4″ C. bolts	.025	.10
2—½″ x 3″ lag screws	.03	.06
8—1½″ x 9″ locust pins	.04	.32
9—Locke insulators, No. 44	.16	1.44
3—house brackets, Line Material Co. No. 3700-P	.17	.51
		$23.49
Purchase, transportation and store costs		3.00
		$26.49
Labor and cartage		10.00
General engineering and accounting		3.65
		$40.14
Contingencies		10.00
Total		$50.14

Investment rates on service lines	
Interest	7.23 per cent
Depreciation and maintenance	7.00 per cent
Taxes and insurance	1.20 per cent
General expenses, contingencies and profit, 15 per cent	2.31 per cent
Total annual	17.74 per cent
Monthly taken at	1.5 per cent
The monthly charge for 150 feet ($50.00×1.5 per cent)	$0.75
Monthly charge per foot of service line (75c÷150′)	0.005

Item C. The transformer charges. (6600-volt transformers adopted as standard construction.)

TRANSFORMER CORE LOSS CHARGE

Size k.v.a.	Watts	Kilowatt-hours per average month of 730 hours	Rate per k.w.h.	Monthly amount	Adjusted charge
1½	33	24.0)		$0.43	$0.45
3	39	28.5)	1.8c	.51	.50
5	52	38.0)		.69	.70

INVESTMENTS

Sizes k.v.a.	Transformers	Lightning arresters, hardware and installation	Total cost	Investment rate same as pole-line	Amount	Taken at
1½	$ 70.00	$106.00	$176.00	1.5%	$2.64	$2.65
3	88.00	106.00	194.00	1.5	2.91	2.90
5	107.00	106.00	213.00	1.5	3.20	3.20

TOTAL TRANSFORMER CHARGE

Size k.v.a.	Core loss charge	Equipment charge	Total Charge
1½	$ .45	$2.65	$3.10
3	.50	2.90	3.40
5	.70	3.20	3.90

(NOTE: The rate of 1.8 cents per kilowatt-hour used for determining transformer core loss charges is the energy cost of 1.608 cents per kilowatt-hours shown above, increased by 12 per cent to cover contingencies, factor of safety, and profits.)

Item D. A single-phase, 6600-volt line is used as the basis of the charge against farmers, but it is intended that as farmers who require transformers larger than 5 kilovolt-amperes are added, or towns and settlements may be served from the line, or other power consumers are added, the line will be changed first to three-phase, and then 4-wire, 3-phase, and the cost of the additional investment will be paid by such additional service. The following is an estimate of the cost of one mile of 6600-volt, single-phase rural line made by Mr. Henry Meade:

2—35′ 7″ W.R.C.A. spec. poles, ½″ treatment	$16.60	$ 33.20
40—30′ 6″ W.R.C.A. spec. poles, ½″ treatment	8.80	352.00
44—3′ 2″ 2-pin fir cross arms	.45	19.80
88—1½″ x 8″ locust pins	.04	3.52
88—22″ cross arm braces	.11	9.68
52—3″ x ½″ lag screws, galv.	.03	1.56
88—⅜″ x 4″ C. bolts	.025	2.20
4—16″ x ½″ d.a. bolts	.15	.60
2—16″ x ⅜″ through bolts	.15	.30
40—10″ x ⅝″ through bolts	.09	3.60
84—2¼″ x 2¼″ x 3/16″ square washers, ¾″ hole	.04	3.36
16—2″ x 2″ x ⅛″ square washers, 9/16″ hole	.02	.32
8—guy hooks	.11	.88
8—pole shims	.06	.48
8—6″ 3-bolt clamps	.24	1.92
4—8″ two-way Everstick anchors	1.35	5.40
4—⅝″ x 6′ anchor rods	.65	2.60
4—½″ guy thimbles	.05	.20
200—feet 5/16 stranded guy wire	.018	3.60
88—Locke No. 44 insulators	.16	14.08
900 lbs. No. 6 M.H.D. copper wire	.17	153.00
15 lbs. No. 6 deadsoft copper tie wire	.19	2.85
		$ 615.15
Forward		$ 615.15
Purchase, transportation and store costs		43.00
		$ 658.15
Labor		200.00
Public liability and compensation insurance		10.00
General engineering and accounting		43.00
		$ 911.15
Contingencies, 10 per cent		91.11
		$1,002.26
Take at		$1,000.00

The pole line investments rate:

Insurance and taxes	1.20%
Interest (money cost)	7.23
Depreciation, maintenance and operation	7.00
15 per cent for general expense, contingencies and profits	2.31
	17.74%
Monthly rate taken at	1.50%
Investments costs, $1000 x 1½ per cent	$15.00

A 6600-volt line is a transmission line when built to connect a transmission substation with a city or town the business of which is ample to warrant the construction; therefore, a 6600-volt rural distribution line should automatically become a transmission line when the transmission line charge, included in the demand and electricity rates of each consumer multiplied by the demand of the consumers on the line, is sufficient to balance the transmission line costs of the line.

The annual transmission line costs for 1921 ...	$205,092.31
The consumer demand months	382,921.00
The transmission line costs per demand month	.536
The value per demand month is taken at ...	.50

This allows for about an 8 per cent safety factor.

The charge per kilowatt of demand per mile per month should therefore be \$15.00—0.50×(the sum of the consumer's monthly billing demand÷miles of line)÷(the sum of the consumer's monthly billing demand÷miles of line). The expression "the sum of the consumer's monthly billing demand÷miles of line" is shortened to "demand miles," and the shortened statement of the charge is: "The difference between \$15.00 and 50 cents×the number of demand miles of the line÷the number of demand miles."

The monthly billing demand: Tests on twenty residence consumers in Cedar Rapids, Iowa, with fifty readings gave an average of 778 watts. This group comprises consumers who were thought to be somewhat above the average, and urban residences, in all our calculations, have been given an average of 750 watts. The maximum load was 1.10 kilowatts. It was decided that the number of maximum variations were so few and the difference in demand costs for the ordinary variations from the average would not offset the extra cost and complications of placing residences which comprise about 85 per cent of our consumers, on a metered demand basis, or even to base the demand on equipment installed, so long as the largest device is limited to 750 watts, or on floor area, number of rooms, number of sockets, etc. We believe none of these methods are an economic necessity for the ordinary residence service, but that an average demand can be obtained which would meet 95 per cent of the conditions with maximum discrimination in costs no greater than would be the extra cost of a measured demand.

No data was available on rural business, but as there will be more lights due to the farm buildings it was thought that one kilowatt would be a safe value where no device exceeds 750 watts.

Where a device larger than socket devices was used, it was assumed that devices up to 2½ k.w., due to the greater diversity in farm use of large devices over commercial urban use that a 2½ k.w. device would have no greater demand on the transmission line and power plant of a number of farms than would ½ k.w. for the same number of urban users.

Likewise a device larger than 2½ k.w., but not larger than 6 k.w., is given as the equivalent demand of 1 k.w., and a device larger than a 6 k.w., but which is not too large for a 5 k.v.a. transformer would have an equivalent demand of 1½ k.w. These added to the 1 k.w. for the socket devices gives 1½, 2, and 2½, respectively, as the monthly billing demands where devices larger than socket devices are installed.

The contract and rates provide for a modification of these estimated monthly billing demands whenever authentic data is available.

Item E. The Demand Charge. The capacity expenses consist of all transmission costs and of all production costs except fuel, boiler room labor and water (for boilers). The latter expenses are classified as energy expenses, although this division of production expenses is not technically correct, since a small portion of fuel, boiler room labor and water (for boiler) expenses are truly a capacity expense and a small portion of the other expenses are truly an energy expense. Yet, after making a careful analysis, it has been found that the error caused by using this simple method of division does not introduce an error of more than two per cent over what the results would be if obtained by the more complicated method of division. Interest at the average rate of the cost of money on interest bearing obligations and preferred stock is included as an item of expenses. The production and transmission expenses used in this supporting data were obtained by an allocation of the company's expenses by the company's "Standard Manual for the Determination of Unit Costs of Electric Service." The capacity expenses are more difficult to take care of in rates, that is, to do so in an equitable manner than are any of the other costs. If they are introduced as a flat kilowatt-hour charge, then all those consumers who used the equipment longer hours than the average pay more than they should, and those who use the equipment shorter hours than the average pay less than they should. If the capacity expenses are introduced as a flat demand charge found by dividing the expenses by the sum of the demands of all the consumers, then those consumers who use the equipment longer hours than the average pay too little for the service and those who use the equipment shorter hours than the average pay too much. These statements are made clear by the following examples:

(1) Assume a 100 per cent load factor consumer with a demand of one kilowatt. He should pay for the capacity expenses an amount found by dividing the total capacity expenses by the maximum load on the system. This, say, is \$7 for one kilowatt demand. Assume the capacity expenses divided by the number of kilowatt-hours is 3.7 cents per kilowatt-hour, then the kilowatt-hours used per average month by a 100 per cent factor consumer would be 730, and the cost at 3.7 cents would be \$27.28 minus \$7.00, or \$20.28 more than the cost of the service.

(2) Assume that the same expenses divided by the sum of the demands is \$1.88. It will be seen in this case that the 100 per cent load factor consumer is served for \$7.00—\$1.88, or \$5.12 less than cost. All the above values are consistent in actual practice.

From the above it is evident that by some combination of these two methods wherein part of the capacity expenses are made to function with kilowatt-hours and the balance with the maximum demands of the consumers, an accurate and equitable method would be had for introducing the capacity expenses into rates. The proper combination and values can be readily obtained from two simple equations in which:

x=the unit kilovolt-ampere demand costs of that portion of the total capacity expenses that can be made to function with the k.w.h. supplied the consumers of a system.

y=the unit kilovolt-ampere demand costs of that portion of the total capacity expenses that can be made to function with the kilovolt-ampere maximum demand of consumers of the system.

D=the sum of the maximum demands of the consumers of a system.

P=the maximum demand of consumers of a system on the source of supply or the maximum demand of consumers of a system on distribution substations, or the sum of the maximum demands of consumers of a system on their meters.

K=the kilowatt-hours used by all the consumers of a system.

C=the total capacity expenses of all the consumers of a system.

730=the kilowatt-hours in the average month for one kilowatt of demand at 100 per cent power factor operated at 100 per cent load factor.

The equations are:

$$Kx+Dy=C$$
$$730x+y=\frac{C}{P}$$

From data on forty towns—

C_1=\$67,323.78 for production and transmission.
C_2= 14,079.38 for distribution substations.
C_3= 2,244.08 for capacity portions of meters.

C =\$83,647.24
P_1= 12,720 kilovolt-amperes for production and transmission.
P_2= 23,013 kilovolt-amperes for distribution substations.
P_3= 63,516 kilovolt-amperes for capacity portions of meters.

$\frac{C_1}{P_1}$=\$5.2930 for production and transmission.

$\frac{C_2}{P_2}$= .6120 for distribution substations.

$\frac{C_3}{P_3}$= .0353 for capacity portions of meters.

$\frac{C}{P}$=\$5.9403, the unit capacity cost for 100 per cent load factor.

(The 10 per cent for general expenses is included in this.)

D = 63,516 kilovolt-amperes.
K =3,862,515 kilowatt-hours.

Since the transformer core losses are taken care of individually and greater copper losses can be absorbed in the factor of safety the data will be applicable to rural conditions. Applying the above values in the two equations:

(1) $Kx+Dy=C$

(2) $730x+y=\frac{C}{P}$

(3) $3{,}862{,}515x+63{,}516y=83{,}647.24$

(4) $730x+y=5.9403$

Divide (3) by 63,516

(5) $60.0812x+y=1.3169$

Subtract (5) from (4)

(6) $669.9188x=4.6234$

(7) $x=.0069014$

Substituting value x in (2)

(8) $5.0380+y=5.9403$

(9) $y=.9023$

Adding 10 per cent for contingencies and profits gives

(9) $y=\$.9925$

This is taken at \$1.00 per kilowatt of monthly billing demand. Hence, the demand charges become—

\$1.00 for 1 kilowatt of monthly billing demand.
1.50 for 1½ kilowatts of monthly billing demand.
2.00 for 2 kilowatts of monthly billing demand.
2.50 for 2½ kilowatts of monthly billing demand.

ARTICLE 2

The total energy costs including 10 per cent for general expenses for the forty towns was \$62,109.24 and the kilowatt-hours registered by the consumers meters was 3,862,515, thus making a cost of 1.608 cents per kilowatt-hours. When the value of x (6.9 mills, equation No. 7, Item E) is added to the unit energy cost the result, 2.298 cents, is the electricity base rate.

To this is added 25 per cent to cover contingencies, profit, and a factor of safety. Therefore, the electricity base rate=2.8725, or 2.9 cents.

A. S. A. E. and Allied Activities

Farm Machinery Division Meeting in Chicago

A MEETING of the Farm Power and Machinery Division of the American Society of Agricultural Engineers will be held in Chicago December 1 and 2, at the Great Northern Hotel. The first day's meeting will be devoted to papers and discussions of interest to engineers concerned with the development of farm machinery, and will consist of a morning and afternoon session, with a special luncheon and get-together between the two sessions. At each session a major and a minor topic will be featured. The subject of the combined harvester-thresher will be the major topic for discussion at the morning session of the first day. Engineering problems associated with the development of the "combine" will be a feature of the papers presented. In connection with this discussion reports of work that has been done in crop drying will also be made. Tentative arrangements have been made with Prof. F. W. Duffee, of the University of Wisconsin, as the minor topic for the morning session, to present this year's results of the silo filler tests that he has conducted.

The major topic for the afternoon session will be a paper dealing with the engineering problems involved in the development and application of disk plows. As the minor topic for the afternoon session, the agricultural engineering section of the Alabama Experiment Station will present a progress report on the work it is doing on tractor lugs.

The second day of the meeting will be devoted to a standards round table at which time engineers from the farm-equipment industry will present definite recommendations for standardization, which can be discussed by those present and special committees subsequently formed to consider the recommendations and eventually formulate recommendations for definite standards for adoption by the Society.

North Atlantic Section Meeting at Schenectady

THE North Atlantic Section of the American Society of Agricultural Engineers will hold a meeting at the Hotel Van Curler, Schenectady, New York, December 10, 11, and 12. Plans for the meeting have been in progress for some time and a very attractive program is offered. Elaborate plans are being made by the local committee for the entertainment and comfort of those in attendance at the meeting.

The morning session of the first day, December 10, will be featured by a paper on the general subject of the opportunities of agricultural engineering by F. A. Wirt, president of the Society, an address on agricultural economic problems by S. L. Strivings, master of New York State Grange, and by an address on the effect of electrification on the social and economic life on the farm by prominent state officials of either New York or Pennsylvania. At the afternoon session, B. B. Robb, professor of rural engineering at Cornell University, will present a paper on the organization of agricultural education under state and federal agencies. The discussion in connection with this paper will take up the organization of land-grant colleges, the Hatch and Adams Act, Smith-Lever Act, Smith-Hughes Act, and the Purnell Bill. R. W. Trullinger, specialist in agricultural engineering of the U.S.D.A. Office of Experiment Stations, will address the meeting on the subject of a national program of agricultural engineering research. Cooperative relations between farmers, electric power companies, and manufacturers of equipment is the subject of a paper of C. E. Seitz, professor of agricultural engineering at Virginia Polytechnic Institute.

The evening session of the first day, December 10, will be devoted entirely to the subject of rural electrification. H. W. Riley, professor of rural engineering, Cornell University, will discuss rural electrification from the viewpoint of the agricultural college; C. H. Churchill, of the Adirondack Power & Light Company, will discuss the subject from the viewpoint of the power company; and W. T. Ackerman, of the University of New Hampshire, from the standpoint of the rural electrification experimental project. A paper on electric lighting on the farm will be presented by A. D. Bell, of the Edison Lamp Works of the General Electric Company.

The morning session of the second day, December 11, will open with a paper on recent developments in power farming by an authority on that subject, a speaker at this writing not having been selected. F. J. Bullock, chief engineer of the Papec Machine Company, will discuss the subject of belt speeds and drives. A paper on the farm building situation will be presented by N. S. Grubbs, agricultural engineer for the Portland Cement Association. J. R. Haswell, extension agricultural engineer of Pennsylvania State College, will address the meeting on the subject of farm sanitation problems. The ventilation requirements of livestock is a subject on which O. B. Stichter, of the Louden Machinery Company, will talk. A. paper on paints and varnishes for farm buildings will be presented by a representative of the Paint and Varnish Association.

The afternoon session of December 11 will be devoted to an inspection trip through the plant of the General Electric Company and other local points of interest.

The climax of the meeting will come with the dinner and program of entertainment for Friday night, December 11.

The morning session of the third day, December 12, will conclude the meeting and will be devoted to the presentation of committee reports and a business meeting of the Section.

Twentieth Annual Meeting in California

TAHOE TAVERN at Lake Tahoe, California, has been selected as the place to hold the twentieth annual meeting of the Society and the time is June 23, 24, 25, and 26, 1926.

The Meetings Committee of the Society, headed by L. J. Fletcher, secretary of the Pacific Coast Section, has been formulating plans for the meeting for several months. In addition to the program of papers and reports that will be practically exclusively devoted to the results of new developments of interest to agricultural engineers, the local committee has made tentative arrangements for nearly a week of inspection trips to be made to various points of interest in California at the close of the annual meeting sessions.

It is planned to run a special train from Chicago for members of the Society and others who will attend the meeting from the East, South and Middle West. Reduced railroad rates will be in force at the time of the meeting, and the rates at Tahoe Tavern will be one-half to one-third less what they are during the regular hotel season.

Subsequent issues of the Journal will give more information about the meeting, the program of papers and reports, inspection trips, etc.

U.S.D.A. Publishes List of Experiment Station Projects

THE Office of Experiment Stations of the U. S. Department of Agriculture has just issued a classified list of projects carried on by the state agricultural experiment stations during the year 1924-25. The total number of projects during this period was 5,538, an increase of 245 over the previous year. It represents an average of about 110

projects per station. The number of strictly agricultural-engineering projects was only 3.4 per cent of the total, or 189 projects. The agricultural-engineering projects came under the following general headings: Land clearing, drainage, farm buildings and equipment, farm machinery, farm power, farm water supply, sewage disposal and sanitation, irrigation, materials of construction, and miscellaneous.

While agricultural engineering was eleventh on the list of the number of projects represented station work, it was third on the list showing increases over the number of projects carried on the year previous, which indicates that the increase in the number of agricultural-engineering projects carried on is greater than for most other divisions of agricultural science. The effort of agricultural engineers should be especially devoted in the future to a still greater effort to increase the number of agricultural-engineering projects being carried on by the experiment stations.

Student Activities at Virginia Polytechnic Institute

By D. C. Heitshu

THE Student Branch of the American Society of Agricultural Engineers at the Virginia Polytechnic Institute completed in June a most successful year. It was a success in numbers, activities and products. During the past year the branch had twenty-nine active members, including graduate students, seniors, juniors and sophomores.

The feature of success in which we place most pride is our graduating class of thirteen. This group was the largest graduating from the school of agriculture, and the third largest in the entire college. We also believe that it is the largest group of agricultural engineers to be graduated from any college in the country in 1925. These men are being placed in promising positions with greater success than any of the other graduates from this school. Many fields are being entered, as is shown by the fact that they are tackling everything from supervising tobacco raising in Rhodesia, South Africa, to road construction, tractor and implement sales, teaching, research and graduate work in agricultural engineering.

These men, while in school, held several very important positions in school activities. There were four commissioned officers of the cadet regiment represented, two captains and two lieutenants, while the football team, rifle team, literary societies, honorary agricultural council, and other organizations had several of their main stand-bys represented here. Our graduate group comprised four men this past year. These men are rounding out their work here and are entering various fields of endeavor. One will engineer his own farm in Kentucky without any horses, another will sell horseless farming for the International Harvester Company, while the other two are still working on their theses and are undecided as to their future employment.

The graduate group has some work to its credit for which it is justly proud. The work conducted included an investigation of soy bean harvesting methods, the results of which were published in the "Journal of Agronomy" in July. Other studies were an isolated electric light and power plant study, efficiency tests of hydraulic rams, efficient spray pressure investigation, and a survey of the small power installations used on Virginia farms. The reports of these studies will undoubtedly be published as they are completed.

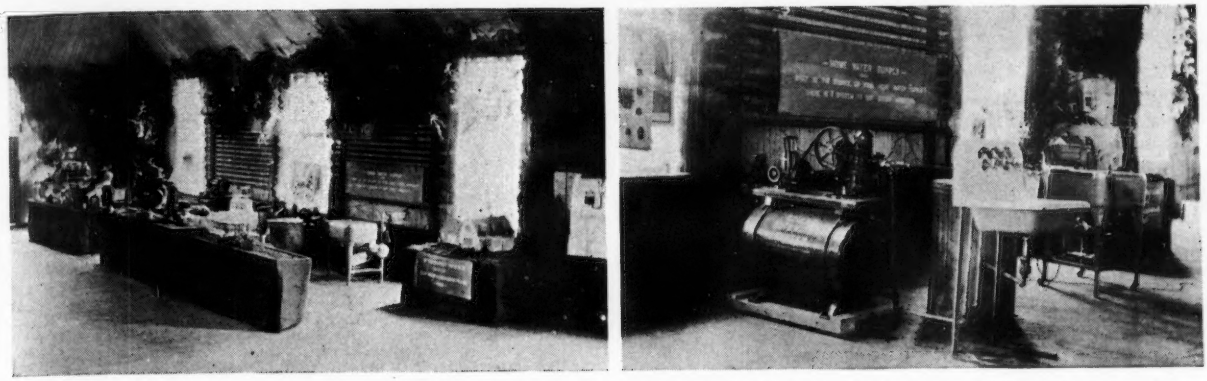
The seniors are not to be outdone in the work accomplished, and claim the honor for most of the testing work in the isolated electric plant study. Also for rebuilding the Nash-Quad and Vim trucks, an Indian motorcycle, and a two-ton Holt "Caterpillar" tractor. The Nash-Quad is the gift of the state highway commission, they having received it from the U. S. War Department. Everyone on the campus said we were crazy to haul in that pile of junk, but it cost only about $75 and some work to change their opinion. Today it will haul more than its rated capacity. The Vim ½-ton truck is the gift of a V.P.I. alumnus, and it was rebuilt at a cost of about $25. The department of agricultural engineering is now using it for practically all its hauling. The Holt Manufacturing Company sent the two-ton "Caterpillar" here for overhauling, and supplied all the necessary parts. Such a good job was done that one of our graduate students bought it for his horseless farm in Kentucky. The motorcycle is another war relic and is the combination of two machines sent us along with the Nash-Quad.

Quite a number of meetings were held during the year, although no regular program was followed. Next year the branch plans for regular meetings. Several smokers with "eats" were greatly enjoyed, but the big feature was the planning and putting on of the agricultural engineering exhibit at the student agricultural fair. Although no judging of exhibits took place, the agricultural engineering exhibit seemed to rank first, judging from the interest the crowd showed in it at all times. The most interesting part of all was to see the electrical and mechanical students marveling at the Kohler automatic lighting and power plant, and looking much like doubting Thomases when it was explained to them. Many of them still claim that some trick was played on them. Every phase of our work was covered: Machinery, gas engines, home appliances, land drainage and rural architecture.

Next year we are planning even greater fields to conquer. We have a very strong class of seniors, having the president of the class of 1926 in our group. The "Virginia Tech," the campus weekly, is practically cornered by ag. engineers, both the editor-in-chief and the business manager being seniors in our course, and in addition, we have several under class staff members. Quite a few of our group are in line for promotion in the cadet corps, and practically every phase of campus activity is represented by some of our boys.

Our meetings for next year will be regular and will alternate business and pleasure. The custom of reading and discussing technical papers will be instituted and should prove

(Left) Eleven of the thirteen 1925 graduates in agricultural engineering at Virginia Polytechnic Institute. Back row: Munn, Clark, Mason. Middle row: Greene, Artrip, Parker, Tucker. Front row: Matthews, Robinson, Tankard, Chestnutt, Wall, ('25½). Cralle and Wood were absent when the picture was taken. (Right) Nash-Quad and 2-ton Holt "Caterpillar" tractor rebuilt by V.P.I. seniors in agricultural engineering



(Left) General view of agricultural engineering exhibit at V.P.I. student agricultural fair. (Right) Close-up view of home conveniences part of the agricultural-engineering exhibit

interesting. Of course, the fair will demand our attention, and with other things, we are counting on another banner year—a better one, if possible.

Rural Electrification Number of N.E.L.A. Bulletin

THE September 1925 issue of the "N.E.L.A. Bulletin," published by the National Electric Light Association, New York City, is called the "Rural Electrification Number," in which is featured abstracts of reports presented at the rural electrification conference held at Madison, Wisconsin, June 26 and 27, 1925, under the auspices of the National Committee on the Relation of Electricity to Agriculture. These reports represent the results of the investigational work in rural electrification that is being done by the state committees on the relation of electricity to agriculture in seventeen different organized states. The reports were made by the project leaders of the state groups and give a comprehensive picture of what is actually being done toward bringing electrical service to the farms of the United States. In nearly every case the project leader is the professor of agricultural engineering at the state agricultural college.

The reports of the project leaders are preceded by an article by Dr. E. A. White, director of the Committee on the Relation of Electricity to Agriculture, which he reviews in a general way the progress that has been made to inaugurate rural electrification projects in the various states, the primary purpose of which is to insure that the development in the application of electricity to agricultural requirements shall proceed along sound economic and engineering lines.

Land Clearing Bibliography

THE activities of the Committee on Land Clearing of the American Society of Agricultural Engineers for the year 1924-25 included the compilation of a bibliography of land clearing. This bibliography has been made available by the Committee in mimeograph form and includes a complete list of all publications on land clearing issued by the U. S. Department of Agriculture and eighteen of the states, and also publications issued by Canada and foreign countries. In addition is a list of scientific works bearing on the subject of land clearing and a list of magazine articles, commercial publications, books, catalogs, etc. The bibliography is complete in every respect.

Copies may be secured from the Secretary of the Society, at St. Joseph, Michigan; the price to members is 25 cents and to non-members 50 cents per copy.

Dr. Mead to Address Chicago Engineers

Dr. Elwood Mead (Hon. Mem. A.S.A.E.), commissioner of reclamation of the U. S. Department of the Interior, will address the Western Society of Engineers, Chicago, October 26. The title of his address is "The Problems of Federal Reclamation."

News of A.S.A.E. Members

J. B. Davidson, professor of agricultural engineering, Iowa State College, is author of Chapter 13, entitled "Agricultural Engineering," of a bulletin issued by the Bureau of Education of the U. S. Department of the Interior on land grant college education from 1910 to 1920. This bulletin is Part III of a series of five bulletins, and is devoted to "agricultural education in land grant colleges."

E. D. Gordon, formerly engaged in teaching machine shop work in the high school at Logansport, Indiana, has recently taken up work as an agricultural engineer with the Central Station Institute. His assignment is with the Commonwealth Edison Company in the generating stations department.

J. Fletcher Goss, graduate fellow in agricultural engineering at Iowa State College, has recently joined the agricultural-engineering staff of the South Dakota State College.

R. B. Gray has resigned as instructor in farm mechanics in the Union High School, Gridley, California, to accept a position in the Division of Agricultural Engineering of the U.S.D.A. Bureau of Public Roads at Washington.

C. D. Kinsman, agricultural engineer, Bureau of Public Roads, U. S. Department of Agriculture, is author of Department Bulletin No. 1348, entitled "An Appraisal of Power Used on Farms in the United States," which recently has been issued.

T. F. Laist has resigned as agricultural engineer for the Northern Hemlock and Hardwood Manufacturers Association to undertake the establishing of a lumber course at Antioch College, Yellow Springs, Ohio.

G. E. Martin has resigned as agricultural engineer of the South Side Development Company, College Station, Texas, to accept a position as extension agricultural engineer at the Oklahoma A. & M. College.

Stanley F. Morse, of the Morse Agricultural Service, announces that, with the addition of his brother, Alan L. Morse, aeronautical engineer, to his staff, he has added airplane dusting to his service, which has been successfully used in combatting insect pests in this country, particularly the boll weevil. Successful airplane demonstrations have been given on cranberries in New Jersey and on apples in Indiana before the Indiana Horticultural Society.

J. L. Strahan has resigned as assistant professor of rural engineering at the Massachusetts Agricultural College where he has had charge of extension work and farm building design, drainage and irrigation, house planning, etc., to accept a position as head of the ventilation department of the Louden Machinery Company, Fairfield, Iowa.

H. B. White and M. G. Jacobson, division of agricultural engineering, University of Minnesota, are authors of a bulletin just issued by the University entitled "Barns."

New A.S.A.E. Members

Franklin A. Beidleman, agricultural engineer, Portland Cement Association, 18 Ridgeway Ave., West Orange, N. J.

Charles Kirby Fox, consulting engineer, Los Angeles, Calif.

Albert C. Heine, instructor in agricultural engineering, West Central School of Agriculture, Morris, Minn.

Eugene Holcomb, Consumers Power Company, Jackson, Mich.

Earl G. Johnson, fellow at the University of Nebraska, Lincoln, Neb.

James C. Marr, associate irrigation engineer, division of agricultural engineering, U. S. Department of Agriculture, Boise, Idaho.

Gottlieb Muehleisen, president and general manager, National Soil Conservation Company, Alma, Wis.

Charles F. Shaw, professor of soil technology, College of Agriculture, University of California, Berkeley, Calif.

Perry T. Simons, drainage engineer, U. S. Department of Agriculture, McGehee, Ark.

E. A. Taylor, manager, tractor and heavy machinery department, Bateman Brothers, Inc., Philadelphia, Penna.

Channing Turner, industrial engineer, U. S. Wind Engine & Pump Co., Batavia, Ill.

Transfer of Grade

Homer H. Doughty, Allenville, Illinois. (Student to Junior Member.)

Applicants for Membership

The following is a list of applicants for membership in the American Society of Agricultural Engineers received since the publication of the September issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Roy E. Murphy, superintendent, of Forestdale Farm, West Burlington, Iowa.

William E. Stanford, instructor in agricultural engineering, Oklahoma Agricultural & Mechanical College, Stillwater, Okla.

Transfer of Grade

Frank D. Jones, instructor in agricultural engineering, University of Tennessee, Knoxville, Tenn. (From Student to Junior Member.)

Books Received

"Farm Mechanics," by B. B. Robb and F. G. Behrends, professors of rural engineering at Cornell University, has just been issued as Vol. I of "Farm Engineering" of the Wiley Farm Series. The book tells how to perform 185 mechanical jobs which every farmer has to do at some time or other, and should know how to do. Each job is fully explained, step by step, backed up with clear illustrations showing the necessary operations. Later the principles and the reasons concerned are developed. The book is the first of a series of two or three volumes, which will cover such general subjects as field machinery, farm gas engines, tractors, etc. The selection and organization of the subject matter are the result of years of practical experience in teaching the material to groups of farmers, extension classes, and students of various agricultural schools and colleges. It is intended to meet the demand for a text book as well as a reference for farmers. The book is organized throughout on the job analysis basis. Each chapter contains a series of jobs covering all the practical angles of the subject. The contents include chapters on harness repairing; knots, hitches, and splices; belts, pulleys, and shafting; soldering; painting; leveling; farm drainage; concrete work; farm water systems; and sewage disposal. The book contains 453 pages, and 470 illustrations. It is published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York City. The price is $2.50 per copy.

"Automotive Repair for Home and School," by H. J. Smith, department of trade and industrial education, University of Minnesota, and Roy S. Kern, director of automotive department, Vocational High School, Virginia, Minnesota, is a working manual of common jobs for students, automobile owners, and repair men. It classifies the common automobile troubles and repair jobs and gives explicit directions as to procedure. For each job there is a statement of why and when it should be done, the tools and materials necessary, the operations in definite order, and cautions where these are especially needed. The contents of the book include engine, clutches, transmissions, universal joints, rear axles, steering gear, brakes, wheels and rims, fuel system, radiator and cooling system, springs and frames, body and fenders, tires and tubes, battery, ignition, magneto, generator, starting mechanism, lighting and signals, lubrication, snubbers and bumpers, and miscellaneous jobs. It is a clear-cut and practical book, and will help solve many a problem for owner or student of automobile repair work. It is published by the Manual Arts Press, Peoria, Illinois, and the price is $1.00.

"Conferences, Committees, Conventions, and How to Run Them" is the title of a new book by Edward Eyre Huff. It is a practical step-by-step book as to the ways and means of conducting meetings of small groups and committees, of conferences, and of conventions. It is designed to save time and money in the conduct of meetings of boards of directors, business committees, political organizations, civic associations, chambers of commerce, sales conferences, trade associations, women's clubs, and the like. In preparing this book the writer's purpose has been to make generally available a body of concrete experience, and to advance what Graham Wallas has called "the future art of rational corporate action." The author of this book, who is connected with the U. S. Department of Commerce, like many other Americans, has been chairman-secretary or member of a variety of organizations. The book is primarily a record of personal experience and observation, the experience having been in the government service and out of it. The book is published by Harper & Brothers, New York City, and the price postpaid is $2.50.

"The National Directory of Commodity Specifications," issued by the Bureau of Standards of the U. S. Department of Commerce, contains in convenient form information regarding the best known specifications for more than six thousand commodities. It tells not only what specifications are in general use, but also by whom they were prepared and where copies can be obtained. In it are conveniently indexed for ready finding about twenty-seven thousand specifications prepared by the federal specifications board and the separate departments of the federal government, by state and city purchasing agents, public utilities, technical societies, and trade associations. The contents include a thoroughly classified list of specifications for all types of commodities. There are also included an alphabetical list of commodities, which serves as an index to the specifications and directions for obtaining copies of specifications listed in the directory. The book contains 385 pages and is bound in cloth. The price is $1.25. Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D.C.

A. S. A. E. Employment Service

This service, conducted by the American Society of Agricultural Engineers, appears regularly in each issue of Agricultural Engineering. Members of the Society in good standing will be listed in the published notices of the "Men Available" section. Nonmembers as well as members, are privileged to use the "Positions Available" section. Copy for notices should be in the Secretary's hands by the 20th of the month preceding date of issue. The form of notice should be such that the initial words indicate the classification. No charge will be made for this service.

Men Available

AGRICULTURAL ENGINEER, 1925 graduate of College of Agriculture, at the University of Illinois, who has specialized in tractors and farm-power machinery and lubrication, and who has had eight years' experience in the operation, repair, and demonstrating of tractors and related farm machinery, desires a position preferably with a farm-machinery manufacturer or oil company. MA-127.

Positions Open

AGRICULTURAL ENGINEER to teach farm buildings, agricultural drawing, rural architecture, and to handle the extension work in farm buildings is needed at Virginia Polytechnic Institute, Blacksburg, Virginia. The work is so arranged that one-half time will be devoted to resident instruction and the other half to extension work. Most of the extension work at present is confined to actual designing of farm structures with some field work. A man is wanted who is capable of developing the extension phase of the work to the highest efficiency. Those interested should write C. E. Seitz, head of the department of agricultural engineering.

SALES ENGINEERS (two) with engineering training wanted to sell retail Fordson industrial tractors in and around the city of Chicago. Ability to recognize a live prospect and to approach factory superintendents, traffic managers, contractors, and business executives is required. Salary to start $50 per week plus 2 per cent commission. Address G. M. Duncomb, care of Dealers' Equipment Co., 3673 So. Michigan Ave., Chicago.

SALES ENGINEERS WANTED: One of the largest bearing manufacturers in America can use the services of two good sales engineers. Men with an engineering education and sales experience in farm tractor and implement field are preferred. They should have designing ability so that they can be of service to customers. Those experienced in the farm-implement and tractor design will be shown preference. Write fully giving all data as to experience, education and salary expected.